FLORIDA SALES TAXES: AN EMPIRICAL INVESTIGATION INTO THE THEORY AND STRUCTURE

By

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For Mary and for Pete

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FLORIDA SALES TAXES: AN EMPIRICAL INVESTIGATION INTO THE THEORY AND STRUCTURE

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This dissertation is a study of the sales and use tax in the state of Florida, the major portion of the study centering around specification of an econometric model of that tax. The model developed is a set of simultaneous equations depicting the relationships between income and gross sales, gross sales and taxable sales, and taxable sales and tax revenues. The structural coefficients of these three equations are estimated for forty-four categories of sales establishment groups.

The relationship between income and gross sales in the establishment groups has not been investigated in the past and the estimated coefficients reveal an ability to explain shifts in the relative volume of sales from one establishment group to another. Also revealed is the percentage of gross sales that are taxable in each of the

groups. Because there are several types of sales that are exempt from the sales tax, this percentage varies substantially over the establishment groups. These exemptions lead to a variation in the effective sales tax rates in the groups although the legislated rate is four percent in all groups except farm equipment. The amount that each of the establishment groups differs from the legislated rate is dictated by the portion of sales in that group that is exempt from the sales tax.

Combination of the income elasticity information with the knowledge that the effective tax rates vary over establishment groups indicates that the various groups have different revenue generating ability associated with changes in income. The specific revenue generation coefficients for each of the forty-four groups are estimated in this study.

CHAPTER I

INTRODUCTION

General Statement

This study is an in-depth look at the income and rate responsiveness of sales tax revenues in the state of Florida. Current economic literature contains several articles dealing with income elasticities of state taxes. Some of these articles consider the income and rate elasticities of various taxes within one state [4;26;30], while others are concerned with comparing elasticities among states [17;22].

The objective of this research is to go beyond previous studies and estimate the income and rate elasticities of Florida's sales tax for various commercial establishment groups. Although Florida's sales tax is for the most part a single rate tax, this study shows that because the base for application of the tax varies among commercial establishment groups, the effective rate varies among these groups.[1]

A brief explanation of this variation is that certain final consumption products, such as food sold for use in the home and certain prescription and non-prescription drugs, are not taxable under state law. Sales of some other products also are not taxable under state law.

These are goods sold by one firm to another for resale, goods sold to any unit of government, and those goods sold to non-profit organizations such as churches. A complete listing of exemptions is found in Chapter 12A-1.01 of Rules and Regulations Florida Sales and Use Tax Law [13].

The major contribution of this dissertation is founded upon this variation in effective rates in conjunction with the expectation that income changes will bring about a change in the mix of total expenditures. This expectation is based on the Engel curve concept, which indicates that as incomes increase, people will spend a larger portion of their income on certain goods while spending a smaller portion on others.

The data required for this model include information on past tax receipts and diverse independent variables determining these tax receipts. Certain variables such as income, population, the tax base, and the tax rate are important in determining tax revenues. Since the base and rate of state taxes are legislated, information regarding changes in these variables is available from the Florida statutes. Income and population figures are available from publications of the United States Department of Commerce and the Bureau of the Census. The sales tax data are obtained from the quarterly report of the Florida Department of Revenue which publishes gross sales, taxable sales, and total taxes due by 'kind' (effectively by commercial establishment categories). A detailed discussion of the sales tax reporting system is included in Chapter II.

The Method of Analysis

In approaching the problem of specifying a sales tax model for the state of Florida, the investigator must be concerned with a combination of the available inputs. This entails combining the present theory of sales tax modeling with the available data for the state of Florida. Chapter II discusses these inputs and gives particular attention to problems associated with the available sales tax data. Chapter III discusses the specification of the model indicating the specific reason for use of each of the included variables. The model is presented below to introduce the reader to the goals of this dissertation as well as the method through which these goals will be attained.

A combination of economic theory and the available data indicates that sales tax revenues in Florida may be described by a set of simultaneous equations of the form

$$(1)\quad GS_i = \alpha + \beta_0 Y + \beta_1 Q_1 + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 Base_{1i} + \beta_4 Rate_i + \varepsilon_{gi}$$

$$(2)\quad TS_i = \gamma + \delta_0 GS_i + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Base_{2i} + \varepsilon_{ti}$$

$$(3)\quad TR_i \equiv TS_i(Rate_i)$$

where

GS_i = gross sales in group i,

Y = a measure of income,

Q_j = a dichotomous variable with value one in quarter j and zero otherwise,

$Base_{1i}$ = a dichotomous variable to reflect changes in gross sales brought about by a base change,

$Rate_i$ = the sales tax rate in group i,

TS_i = taxable sales in group i,

$Base_{2i}$ = a dichotomous variable to reflect changes in taxable sales brought about by a base change, and

TR_i = tax revenue from group i.

The state of Florida is presently estimating taxable sales using the reduced form of equations (1) and (2) as follows:[2]

$$(4)\quad TS_i = \gamma + \delta_0(\alpha + \beta_0 Y + \beta_1 Q_1 + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 Base_{1i} + \beta_5 Rate_i + \varepsilon_{gi}) + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Base_{2i} + \varepsilon_{ti}$$

where i = 1 to 5. The simple linear specification of equation (4) is

$$(5)\quad TS_i = \zeta + \omega_0 Y + \omega_1 Q_1 + \omega_2 Q_2 + \omega_3 Q_3 + \omega_4 Base_i + \omega_5 Rate_i + \nu_i$$

While the reduced form, as shown in equation (5), may be as productive as the structural form for prediction purposes, it yields no information regarding structural coefficients.[3] For this reason, by going straight to taxable sales the investigator fails to recognize the fact that the makeup of total sales may be changing over time, with total sales in one group increasing at the seeming expense of sales in other groups. The policy implications of the various coefficients of the structural equations are sufficiently important to warrant the effort involved in their estimation. These policy implications are concerned with the exemptions to the general sales tax and the actual costs of equity in terms of foregone tax revenues. The coefficients in equation (1) provide information pertaining to shifts in gross sales brought about by changes in the structure of the Florida economy. Expectations of such shifts are based upon the Engel curve concept of expenditures mentioned above. This is basically an income elasticity of expenditures approach.

In order to specify equation (1) correctly, the possibility that the partial $\partial GS_i/\partial Y$ is not constant must be taken into consideration. By Taylor's theorem, an arbitrary function can be expressed by an nth-degree polynomial using the general form

$$(6)\quad (Y) = \alpha(Y_0) + \alpha'(Y_0)(Y-Y_0) + \alpha''(Y_0)(Y-Y_0)^2/2! + \cdots\cdots + \alpha^n(Y_0)(Y-Y_0)^n/n! + R_n$$

where n is the order of the polynomial required to express the function [6, p. 256].

If the second order approximation to the above form is used and the function is expanded around $Y_0 = \overline{Y}$ we get

$$(7) \quad \alpha(Y) = \alpha(\overline{Y}) + \alpha'(\overline{Y})(Y-\overline{Y}) + \alpha''(\overline{Y})(Y-\overline{Y})^2/2 + R_2$$

This gives the ability to approximate gross sales as a nonlinear function of income by substituting $\beta_0 Y + \beta_6 Y^2$ into equation (1), where

$\beta_0 = \alpha' + \alpha''(\overline{Y})$, and

$\beta_6 = \alpha''/2$.

This nonlinear function is a quadratic relationship between gross sales and income, and can be shown in the form

$$(8) \quad GS_i = \alpha + \beta_0 Y + \beta_6 Y^2 + \beta_1 Q_1 + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 \text{Base}_{1i} + \beta_5 \text{Rate}_i + \varepsilon_{gi}$$

Economic theory indicates that $\partial GS/\partial Y (= \beta_0 + 2\beta_6 \overline{Y})$ should be positive for all groups of expenditures because it seems unlikely that an entire expenditure group would fall into the category of inferior goods [20, p. 34]. No such sweeping assumption can be made regarding $\partial^2 GS/\partial Y^2$ $(= 2\beta_6)$. Those expenditure groups whose goods fall into the category of 'luxury goods' should be expected to have positive second order partial derivatives, while those groups made up of 'necessities' should be expected to have negative second order partials.[4]

This theory can be tested through the use of the gross sales and taxable sales data that are available for the state of Florida in 85 expenditure groups. Coefficients of equations (1), (2), and (5) can be estimated in those

85 groups.[5] If, when these expenditure functions are given their proper specification, the results show that there appears to be variation in the degree of sales responsiveness to income among the groups, then the present linear specification of equation (5) is in general biased [22, p. 400].[6] Allowing income to enter the equations to other than the first degree will decrease the bias inherent in estimating a nonlinear function using a linear form. This is possible using the reduced form reflected in equation (5) if the specification of the reduced form takes into consideration the arguments of equation (8) instead of equation (1).

The level of aggregation of the sales data is also important. The state is presently estimating equation (5) in five groups, while sales data are available in 85 categories. With the assumption of linear realtionships between taxable sales and income, the combination of groups need not in itself bias the estimates of the coefficients of equation (5). In fact the only loss may be that of information regarding the specific groups. But once it is recognized that different groups have various nonlinear relationships the ability to estimate coefficients in combined groups without bias is severely limited [16, p. 100].

In summary, there are two objectives in what is being set out here. The first is to aid long run forecasting by revealing information regarding structural shifts in the total available tax base. The second is an improvement in the techniques of short run revenue forecasting by moving from a linear to a quadratic form.

An Overview

The remainder of this dissertation is made up of three chapters. Chapter II surveys the literature, discusses the present tax modeling being done by the state of Florida, and investigates the available data. The exact specification of the model is carried out in Chapter III, and the pertinent coefficients are estimated. Conclusions are drawn together in Chapter IV. That final chapter also considers the policy implications of the theory set forth in this dissertation.

Notes

1. The legislated rate is four percent in all cases other than some equipment used in farming, in which case the tax is applied at a three percent rate.

2. This information is from conversations with Tony Huggins and Bill James of the Department of Administration in July and September 1975, respectively. The information gained from these conversations indicated that lagged independent variables were also included in the specification. Additional information pertaining to the tax structure of Florida can be gained from Baarda [2] and certain State of Florida publications [9;11;12].

3. The reduced form does give unbiased coefficients and its use may well be preferred for prediction purposes because of the positive characteristic of simplicity. This of course assumes that all other things are held constant, such as the number of groups and the constraint of linearity.

4. We should never lose sight of the fact that this is not consumption data and therefore complications may besiege the investigator.

5. In this work some number of these groups will be combined because of their striking similarity. Also, in order to obtain consistent estimates of the coefficients in equation (2), two stage least squares are required since the dependent variable in equation (1), gross sales, is not expected to be independent of the error term in equation (2). This occurs because in this set of simultaneous equations the extraneous factors affecting gross sales are also expected to affect taxable sales.

6. The concept of a system of expenditure functions is not used in the conventional manner here. The constraint of

$$\sum_i GS_i = Y$$

does not hold as there are complications with the gross sales data, and total sales do not equal total consumption. Some of the reasons for this are that the gross sales figures include intermediate sales (sales by one firm to another for resale), and they do not include housing expenditures.

CHAPTER II

BACKGROUND AND INPUTS

Introduction

This chapter contains three major sections. The first is a discussion of the existing literature dealing with the modeling of state revenues. The second section describes the method of sales tax revenue modeling employed by the state of Florida and analyzes its specification. The final section of this chapter discusses the data and their accuracy.

Previous Theoretical Work in Tax Modeling

Groves and Kahn

In 1952 Groves and Kahn [17] investigated the stability of state and local tax yields. Their work was founded on the concept of income elasticities of tax revenues. These income elasticities were computed for various taxes in a number of states using the equation

(9) $\log T = \log a + e \log Y$

where

T = the tax yield,

Y = income payments, and

e = the income elasticity of revenues.

These taxes were then classified as being of either low income elasticity (0. to .80), medium income elasticity (.81 to 1.20), or high income elasticity (1.21 and over). It should be pointed out that Groves and Kahn stated that they were restricted to " ... taxes whose yields remained relatively uninfluenced over a reasonable period of time by changes in the law concerning rates, definition of the tax base, or administration"[17, p. 91]. Their model, given these constraints, provides some general information concerning various types of taxes, but prevents in-depth investigation of most taxes, as most state taxes have experienced rate and base changes over time. Also any forecasting attempts are prevented if these restrictions are not met.[1]

Wilford

Wilford, in a 1965 National Tax Journal article [30], suggested a method of including a change in the tax rate into the model using the equation

(10) $\log R = \log c + e \log Y + f \log r$

where

R = tax revenue,

Y = aggregate personal income,

r = the tax rate, and

f = the rate-revenue elasticity coefficient.

With this modification, changes in the tax rate need no longer restrict the ability to estimate the income elasticity of tax revenues, but such changes add a new dimension to the estimating process.

Wilford also suggested the use of per capita income as the relevant income measure instead of aggregate personal income as was used by Groves and Kahn. He states that "This difference ... may become significant in analyzing the stability of a revenue structure from elasticity coefficients"[30, p. 300]. This variation between the effects of changes in per capita and aggregate income on tax revenues should be expected because of the 'market basket' effects of changes in per capita income. As consumers adjust their market baskets in accordance with higher incomes the average tax rate of the entire basket may well be expected to change.[2] On the other hand, if aggregate income increases are offset by increases in population, the market baskets of consumers may retain their makeup while total demand increases.

Legler and Shapiro

The discussion of the relative impacts brought forth by changes in aggregate income vis-a-vis per capita income was continued to some extent by Legler and Shapiro [23], although their major contribution appears to lie in other areas.

Legler and Shapiro continued to increase the sophistication of the theoretical model by including the interdependence of different taxes. This is more obvious in its importance when the state under consideration has an income tax. As consumption of taxable goods can be expected to be a function of disposable income, an increase in the state income tax should result in a decrease in sales and use tax revenues.[3]

Another important factor in the work of Legler and Shapiro was their specification of the sales tax portion of the model in a form allowing the existence of various rates. This was done using the following identity:

(11) $R \equiv r_1 Y + r_2 C_t$

where

R = tax revenues,

r_1 = income tax rate,

Y = aggregate state income,

r_2 = a vector, each element of which is the sales tax rate on different commodities, and

C_t = a vector of gross sales of differently taxed items.

The consumption function for taxed goods was then written

(12) $C_t = C_t(Y, y, N, p, r_2)$

where

y = per capita income,

N = population, and

p = a vector of prices.

This specific contribution by Legler and Shapiro is important in this dissertation, as it was one of the first indications that tax revenues can best be specified using a set of simultaneous equations.

Friedlaender, Swanson, and Due

Friedlaender, Swanson, and Due [14] set forth a model to estimate rate and income elasticities of sales tax revenues using the following simplifying assumptions [14, p. 106]:

> 1) Per capita income and growth of per capita income of the state are independent of tax yields.
>
> 2) The estimates are short run; therefore the interdependence between state expenditure patterns and the structure of the tax base and tax rate can be assumed as given. Longer run projections would necessitate inclusion of simultaneous equations identifying the interdependencies between expenditures and revenues.[4]
>
> 3) The interrelationships among various taxes in the tax structure of each state are insignificant. A change in the rate or base of one tax in a given state does not significantly affect the yield of another tax in that state.
>
> 4) The supply of taxed commodities is infinitely elastic within the relevant range. Thus sellers' prices (pretax) are independent of output and the tax rate.

Using these assumptions they use the equation

(13) $R_s = r_s C_s$

where

R_s = sales tax revenues,

r_s = sales tax rate, and

C_s = consumption expenditures on taxable commodities.

They chose to use the arguments of Legler and Shapiro as well as Wilford to express the sales tax equation. Their estimation of the equation of sales tax revenues for the ith state was as follows:

(14) $\log R_{si} = B_1 \log y + B_2 \log N_i + B_3 \log r_{si} + \log u_i$

where u is a random disturbance term. Relative prices were dropped from the equation as the authors stated that they " ... added nothing to the statistical estimation"[14, p. 107].

Berney and Ferichs

The set of independent variables presented in equation (14) was altered in the work of Berney and Ferichs [4] by dropping population and including a measure of the tax base.

Berney and Ferichs took an applied approach in their research by comparing the predictive power of the model actually being used by the Department of Revenue of the state of Washington to the predictive power of the following equation:

(15) $\log T = \log a + e \log Y + f \log R + g \log B$

where B is the tax base. Their conclusion was that equation (15) " ... provides statistical results equal to the non-logarithmic model tested"[4, p. 423]. The non-logarithmic model they referred to was only identified by the fact that it was " ... similar to those used in Washington for forecasting tax revenues." The only elaboration on the state of Washington model was " ... the independent variables for this set of non-logarithmic models are state personal income, covered employment, and the consumer price index"[4, p. 421]. No specification of such a model was given. They also stated that " ... since the theoretical rationale for the multivariate elasticity model is stronger, it would appear to be the most desirable" [4, p. 423].

Strong questions remain as to whether sufficient investigation had been carried out to make such a decision. Admittedly the results presented by Berney and Ferichs [4, p. 420] did not indicate one method as a more powerful predictor than the other, but there remains a strong possibility that further investigation would have added a great deal more information in their specific case.[5] Their suggestion that the state of Washington abandon its method of forecasting revenues leads one to question the methods of tax modeling actually being employed by state governments.

The Applied Florida Model

The authors of the papers discussed above used multiplicative entry of independent variables and log-linear estimation of coefficients. On the other hand, those people actually forecasting revenues for state governments have generally used, at least in the case of Florida, a straightforward linear model of the form[6]

(16) $S_{ti} = \alpha + \beta_{1i}Q + \beta_{2i}Y + \cdots + \varepsilon_i$

where

S_{ti} = taxable sales for group i,

Q = a variable which allows for quarterly variation, and

Y = a measure of income.

Other variables such as unemployment and lagged dependent variables appear in the specification of the various groups. The Department of Administration of Florida has in the past estimated taxable sales in the following five categories:

Auto and Accessories,
Farm Investment,
Nonfarm Investment,
Other Consumer Durables, and
Consumer Nondurables.

After estimates are made of taxable sales, the remaining requirement for estimating sales tax revenues is shown by

(17) $R_s = \sum_{i=1}^{5} r_i S_{ti}$

where

R_s = revenues from sales taxes, and

r_i = the tax rate for group i.

Since tax rates are legislated, there is no problem in the calculation of equation (17).[7] The difficulty in using this approach lies in the estimation of equation (16).

The Data[8]

The Source of the Sales Data

The data for this investigation are obtained from the State of Florida Department of Revenue quarterly sales tax report. These data are used from the first quarter of 1964, as there were major revisions in the reporting categories at that time.[9] These data are, as mentioned earlier, reported by 'kind', or commercial establishment (see Table I). These data were reported in eighty-two categories until the second quarter of 1968, when three more categories were added because of the base and rate changes ocuring at that time. In this work the eighty-five categories have been gathered into forty-four groups, each consisting of similar commercial establishments (see Table I). The justification for such grouping is a strong belief that purchases from each category of establishment in any one group react in like manner to income variation and seasonal trends. Also it may be noticed that there are several categories not grouped with any of the others. It must be emphasized that the sales data used here reflect gross expenditures, and not consumption, in each of the categories. For this reason, intermediate sales should be expected to have an important impact on the results of this study.

Problems with the Sales Tax Data

One problem with the sales tax data is that a given

TABLE I

CLASSIFICATION OF REGRESSION GROUPS BY RETAIL ESTABLISHMENT

REGRESSION GROUP	ESTABLISHMENT GROUP[a]
1	1. Grocery Stores 2. Meat Markets 3. Seafood Dealers 4. Vegetable and Fruit Markets 5. Bakeries 6. Delicatessens 7. Candy and Confectionery
2	8. Restaurants and Lunchrooms 9. Taverns and Night Clubs 77. Vending Machines
3	10. Clothing Stores 11. Shoe Stores 12. Hat Shops
4	13. Department Stores 14. Variety Stores 20. General Merchandise Stores 21. Second Hand Stores 22. Dry Goods Stores 75. Trade Stamp Redemption Centers
5	15. Drug Stores
6	24. Auto Accessories, Tires, Parts 26. Garages and Repair Shops
7	23. Motor Vehicle Dealers
8	25. Filling and Service Stations
9	27. Aircraft Dealers
10	29. Furniture Stores 30. Household Appliances 32. Music Stores, Radios, TV
11	31. Store and Office Equipment
12	60. Holiday Season Vendors
13	59. Admissions

TABLE I CON'T

REGRESSION GROUP	ESTABLISHMENT GROUP[a]
14	40. Auctioneer, Commission Dealers 47. Scrap Metal, Junk Yards 54. Storage and Warehousing 78. Importing and Exporting 80. Wholesale Dealers
15	57. Social Clubs, Associations
16	48. Itinerant Vendors
17	66. Communications
18	39. Hotels, Apartment Houses, etc.
19	68. Graphic Arts - Printing 73. Advertising
20	79. Medical, Dental, Surgical, Hospital
21	67. Transportation
22	69. Insurance
23	28. Motorboat and Yacht Dealers
24	16. Jewerly, Leather, Sporting Goods 42. Book Stores 43. Cigar Stands, Tobacco Shops 55. Gift, Card, and Novelty Shops 56. News Stands 65. Pawn Shops
25	81. Schools, Educational Institutions
26	70. Sanitary, Industrial Supplies 71. Packaging Materials - Paper Bags
27	45. Fuel Dealers
28	82. Office Space and Commercial Rentals
29	83. Parking Lots, Boat Docking, and Storage

TABLE I CON'T

REGRESSION GROUP	ESTABLISHMENT GROUP[a]
30	84. Utilities, Electricity or Gas
31	33. Building Contractors 34. Heating and Air Conditioning 35. Electrical and Plumbing 36. Decorating, Painting, Papering 37. Roofing and Sheet Metal 38. Lumber and Building Materials 62. Fabrication, Sales of Cabinets
32	18. Hardware, Paints, Machinery
33	74. Top Soil, Clay, Sand, Fill Dirt
34	76. Nurseries and Landscaping
35	50. Machine Shops and Foundries
36	58. Industrial Machinery, Equipment
37	63. Manufacturing, Mining
38	61. Rental of Tangible Property
39	41. Barber and Beauty Shops 44. Florists 46. Funeral Directors, Monuments 49. Laundry and Cleaning Services 52. Photographers, Photo Supplies 53. Shoe Repair Shops 72. Repair - Tangible Personal Property
40	51. Horse, Cattle, and Pet Dealers
41	64. Bottlers - Beer and Soft Drinks
42	99. Miscellaneous
43	17. Feed and Seed Stores
44	19. Farm Implement Dealers

---

a. Department of Revenue Retail Establishment Classes.

change in the tax base of group i can have what appears to be an unrealistic impact on the reported total expenditure figures of group i.[10] This can occur because sales by an entire subset of group i may not be reported if none of the subset's sales are taxable. A base change, which might include only one-tenth of one percent of the sales of the mentioned subset, would cause all sales of the subset to begin being registered in the total expenditures figure for the group. To elaborate, if none of a firm's sales are taxable, there is no requirement that that firm file a monthly report with the State Department of Revenue, but if any portion of the firm's sales are taxable, then the report reflecting total sales must be filed. The magnitude of this impact can be measured by the percentage of group i made up by the subset under consideration. Although this does affect the specification of the expenditure function of group i it is by no means insurmountable. Information is available summarizing the pertinent base changes (as well as rate changes), so that such changes can be incorporated into the specification of the model.[11]

Another point to be made concerning these data is that they represent establishment, rather than product groups, and it is therefore difficult to distinguish between such generally used classifications as consumer durables and nondurables. For example, large discount stores sell a large range of goods from shoes to tires to refrigerators, but their total sales figure is entered into one specific group. This could be group thirteen, department stores, or group fourteen, variety stores, but as long as the classification of the specific establishment is consistent, there should be no major complication in the specification of the model.

The Independent Variables

The explanatory variable expected to give the most power to the specification of this model is a measure of income.[12] A quarterly series of Florida personal income is available from the Survey of Current Business and is used in this study.

State population figures are available in the form of annual estimates from the Bureau of the Census. This can be adjusted to quarterly data in order to arrive at per capita income.

Also of major importance are legislated variables, such as the rate and base changes for each taxed group. Proper specification dictates that adjustments be made when there is a change in either of these important variables.

Summary

The literature discussed in this chapter develops theoretical justification for several variables that should be most helpful in the specification of a sales tax model.

The specification of this model, in Chapter III, considers variables such as changes in tax rates (mentioned by Wilford) and changes in the tax base (specified in the Berney and Ferichs model).

The data for this dissertation come from various published sources. Sales tax data come from the quarterly report of the Florida Department of Revenue, while data for independent variables come from various state and federal publications. A detailed summary of the various data sources appears in Appendix II.

Notes

1. Of course an assumption of unitary rate elasticity will allow an adjustment to the data, so that a forecast can in fact be made when there has been a change in the rate.

2. In Florida this may be expected to be a shift toward taxable goods because food sold for consumption in the home is not taxed. A number of studies have shown expenditures on food to be relatively income inelastic [1;3;5;6].

3. As Florida does not have an income tax this interdependence may be minimized, although a change in the tax rate of any taxed good will alter the relative price of that good (albeit by a small amount) in relation to all other goods.

4. This assumption need no longer be made using the specification as set forth in this dissertation. The arguments for specifying a model which will allow state budget makers insights into the interdependence between state expenditure patterns and the structure of the tax base and (effective) tax rate are numerous. These budget makers should have a relatively specific understanding of where future revenue will originate, and should have the capacity to make relatively accurate long run forecasts.

5. A simple statistical device such as the estimate of the standard error of regression divided by the mean of the independent variable, should give some information as to the more accurate of the estimators.

6. This information is from Bill James of the Florida Department of Administration.

7. This is complicated to some extent by the fact that there are certain legislated 'loopholes' in the surrender of these tax funds to the state. Most important is the three percent collection allowance. For this reason the State Department of Administration uses a figure somewhat below the legislated four percent.

8. Detailed information concerning the source of all the data used in this study appears in Appendix II. Any adjustments made to the published data are also fully explained in that appendix.

9. This information is from Tony Huggins of the Florida Department of Administration.

10. This was mentioned by Bill James of the Florida Department of Administration in a telephone conversation on September 16, 1975.

11. A summary is available from the Department of Administration [10].

12. This expectation is founded on the theory which was discussed briefly in Chapter I. The discussion will be carried to greater detail in Chapter III.

13. In addition to those articles discussed at length, articles by Due [8]; Hambor, Norman, and Russell [18]; Hanson [19]; Morgan [25]; and Shapiro and Legler [27] have been investigated in the preparation of this dissertation.

CHAPTER III

SPECIFICATION OF THE MODEL

Introduction

This chapter contains a detailed discussion of the specification of the model. Each of the variables in equations (1), (2), and (3) is considered, and theoretical justification for its inclusion is made. The basis for the structure of the equations is stated in this chapter, and the value of each structural coefficient is given as each of the independent variables is discussed.

The Gross Sales Equation

The gross sales equation is

$$(1) \quad GS_i = \alpha + \beta_0 Y + \beta_1 Q_1 + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 \text{Base}_{1i} + \beta_5 \text{Rate}_i + \varepsilon_{gi}$$

This specification is discussed briefly in Chapter I above. In this section, detail is given to each of the variables in this equation as well as the form of the equation itself.

Income

Personal income is expected to exert a major impact on expenditures (gross sales) in each of the regression groups.[1] Beginning with the work of Groves and Kahn and moving through all the previous work in the area of tax modeling, income has been the variable around which all the models have been structured. The basis for inclusion of income as an explanatory variable in a sales tax model is that sales of most goods, and surely most groups of goods, are expected to be direct functions of income. Simply stated, as incomes increase sales are expected to increase, and likewise sales tax revenues are expected to increase.

The possibilities are for these increases to be either at increasing, constant, or decreasing rates. The specification of equation (1) restricts the relationship between gross sales and income so that increases in gross sales must be a constant linear function of income. Through the use of a second degree income term such as that in equation (8), the theoretical requirements of increasing or decreasing rates of change in expenditures as a function of income are made possible. The structure of equation (8) allows the investigator to hypothesize the income responsiveness of sales in each of the regression groups, and then test that hypothesis using the available data.

$$(8) \quad GS_i = \alpha + \beta_0 Y + \beta_6 Y^2 + \beta_1 Q_1 + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 \mathrm{Base}_{1i} + \beta_5 \mathrm{Rate}_i + \varepsilon_{gi}$$

In Appendix I each of the forty-four regression groups is discussed briefly, and, if the investigator has strong preconceived notions concerning the expected value of $\partial^2 GS_i / \partial Y^2$, such notions are mentioned.[2]

Relative Prices

There are theoretical grounds for the use of relative prices as an explanatory variable among the various groups. Unfortunately, such data are not available for the state of Florida, and, in fact, are available quarterly for the United States only in a much more aggregated form than the available sales tax data. These United States price data are used to deflate the sales tax data, although the lack of accuracy entailed in fitting the small sales tax categories within the large deflator categories precludes the construction of a relative price vector for use as an independent variable.[3] The specific deflator used to adjust each of the regression groups is given in Table II.

Base Changes

The need for a variable to account for a tax base change is due to a measurement problem. The data indicate that an increase in the tax base for establishment group i can lead to a sizable increase in gross sales in establishment group i. This might superficially appear to be theoretically unsound. Any increase in the base should be perceived by the purchaser as a price increase in those

TABLE II

REGRESSION GROUP DEFLATORS

GROUP	PRICE DEFLATOR GROUP	GROUP	PRICE DEFLATOR GROUP
1	Food and Beverages	23	Durables
2	Food and Beverages	24	Other Nondurables
3	Nondurables	25	Other Services
4	Nondurables	26	Nondurables
5	Nondurables	27	Gas and Oil
6	Autos and Parts	28	Other Services
7	Autos and Parts	29	Other Services
8	Gas and Oil	30	Housing Operation
9	Other Durables	31	Housing
10	Furniture	32	Other Durables
11	Other Durables	33	Services
12	Other Nondurables	34	Services
13	Consumer Services	35	Other Durables
14	Other Services	36	Other Durables
15	Consumer Services	37	Other Durables
16	Other Nondurables	38	Consumer Services
17	Other Services	39	Consumer Services
18	Consumer Services	40	Other Services
19	Other Services	41	Food and Beverages
20	Other Services	42	Consumer Price Index
21	Transportation	43	Nondurables
22	Other Services	44	Other Durables

products in group $\underline{i}$ heretofore not taxed. This should lead the investigator to expect gross sales to decrease to some extent in group $\underline{i}$.

Close inspection indicates that firms whose sales are altogether untaxed are not required to submit sales report forms to the Department of Revenue. For this reason the sales of such firms are not included in what is referred to here as gross sales. An increase in the tax base may cause some portion of the sales of a previously untaxed firm to become taxable. This action will require the firm to complete and submit a form to the Department of Revenue, and all its sales (both taxable and non-taxable) will then be included in the gross sales of the group within which the firm is classified. The extent of the change in taxable sales figures will be determined by the portion of the firm's sales which are included in the base change, while gross sales will be altered by the entire amount of the firm's sales.

This variable is included in the specification for those regression groups that have experienced base changes over the period of the sample. The information necessary to determine whether or not it is desirable to include a variable for such base changes is found in a summary obtained from the Florida Department of Administration [10]. The exact specification of the base change variable associated with any regression group is included in the discussion of that specific regression group in Appendix I.

This variable enters the equation as a zero-one dummy. The significance of the variable is dictated by the relative magnitude of the additional gross sales relative to total sales in the expenditure group.

Rate Changes

Rate changes should be perceived by the purchaser as price changes. Given the fact that the state of Florida has a general sales tax, an increase in the tax rate of from three to four percent should simply be seen as a slight price increase, and theoretically the consumer should decrease his purchases of the taxed item.

It is not felt that this variable is significant in altering the value of the gross sales variable for two major reasons. First, the impact of a one-percentage point change in the tax rate, as occured in the available sample in 1968, will not change purchasing habits by a statistically significant amount. The second reason lies in the fact that the tax is a general sales tax, and, although certain goods are exempt, it is unlikely that the purchaser could easily substitute untaxed for taxed goods in order to satisfy his needs. Theoretically the act of levying a tax or increasing the tax rate on one good should alter the relative price of that good and change the makeup of total expenditures through substitution of non-taxed for taxed goods. In the instance of Florida sales taxes, it is felt that the cross elasticity between taxed and non-taxed expenditure groups is very small because of the wide base of application and nature of exempted goods.[4]

In summation, theory indicates that there is a negative relationship between tax rate changes and gross sales. It is not anticipated that this relationship is statistically significant, however, for the reasons indicated above.

Quarterly Variation

Gross sales in certain of the establishment groups are expected to vary from quarter to quarter. This is because the state is heavily dependent on tourism and agriculture. Both industries display a high degree of seasonality. In addition, department stores, gift shops, and other such establishments show the seasonality of Christmas shopping. Automobile purchases are also expected to be of a seasonal nature based mainly on the industry's introduction of new models each year.

Equally important in the justification for the inclusion of a variable which allows quarterly variation is the fact that the income data used here are seasonally adjusted and the gross sales data are not. This method of regressing non-adjusted data on adjusted data in conjunction with dummies to offset the adjustments is readily acceptable.

These arguments give justification for the inclusion of zero-one variables for seasonal fluctuation in gross sales in each of the establishment groups [28].

The Form of the Equation

The gross sales equation includes the variables discussed above in the form of equation (8). This particular configuration is chosen because it satisfies each of the theoretical necessities described above while retaining the maximum degree of simplicity.

Income enters in a nonlinear fashion. The second degree income term allows expenditures in any given establishment group to increase as either an increasing, decreasing, or constant function of income.

The quarterly variation variables enter in a zero-one dummy fashion for quarters two, three, and four leaving quarter one as the base quarter. By using the variables Q_1 and $Q_1(Y)$ in equation (8) tests can be made for the possibility that the relationship between income and gross sales differs between the base quarter and quarter two.[5] The variable Q_1 allows for a linear shift in the relationship reflected by an alternative intercept term in the various quarters. The variable $Q_1(Y)$ allows the relationship to differ between quarters by allowing the slope terms to change from quarter to quarter. In the event that both of these have coefficients significantly different from zero there is no gain from the use of the dummy variables. The coefficients in the statistically unique quarter (or quarters) can be estimated independently from the other quarters. This is taken into consideration, and the coefficients of each of the establishment groups are inspected in detail when the coefficients are estimated. The results of the estimation process are presented in Appendix I, where all of the significant estimated coefficients are given.

The base change variable also has a zero-one dummy type entry into the equation. In the instance of a base change the data has to be checked for the possibility that such a change has brought about an intercept shift as well as a slope shift. Thus, when specifying equation (8) the variables $Base_i$ and $Base_i(Y)$ are used to investigate the relationship between gross sales and base changes. As mentioned above, Appendix I explains how determination is made concerning the use of these variables. The results of the estimation procedure are presented in Appendix I.

The rate change variable enters the equation in a straightforward manner, reflecting the percent of taxable sales to be paid by the purchaser in each of the establishment groups. The rate on most taxable items was three percent until the second quarter of 1968, at which time the rate was increased to four percent. Those establishment groups possessing tax rates other than the general rate are identified in Appendix I.

It should be reiterated that in every case the rate variable is not expected to appear to be statistically significant in the determination of gross sales. In those instances where the tax rate and base both changed during one time period the assumption is made that any change in gross sales is precipitated by the base change as the expectation is that the base change should have the larger impact.

The coefficients of the gross sales equation are estimated for the forty-four regression groups, and all the significant coefficients are presented in Appendix I.[6] This estimating procedure is the first step in obtaining the necessary coefficients to investigate the specific impact of tax policy upon the Florida economy. It is also the first step in determining the relationship between changes in gross sales and changes in tax revenues, a relationship influenced by the fact that the state of Florida allows exemptions to the general sales tax.[7] The next step is to specify the taxable sales equation represented by equation (2).

The Taxable Sales Equation

Gross sales differ from taxable sales over the various establishment groups for a number of reasons. These reasons include, but are not limited to, the tax exempt status of the sale of prescription and non-prescription drugs and food sold for consumption in the home. Certain purchasers also enjoy tax exempt status. Such purchasers include churches and other non-profit organizations as well as any unit of government.[8] The combination of these and other factors indicates that each establishment group retains a stochastic relationship between gross sales and taxable sales.

The structural form of the taxable sales equation is

$$(2) \quad TS_i = \gamma + \delta_0 GS_i + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Base_{2i} + \varepsilon_{ti}$$

The theoretical justification for inclusion of these variables, as well as the form of the equation, are discussed in the following section.

Gross Sales

The relationship between gross sales and taxable sales is the determining factor in what can be referred to as the effective tax rate in each establishment group. With a legislated general tax rate which covers the entire establishment group there is no requirement for the specification of this equation; total sales and taxable sales are the same. One would simply multiply total gross sales by the legislated tax rate to arrive at tax revenues. But if legislation causes the tax base in any establishment group to be different from total sales, a divergence between effective and legislated tax rates is created.

The actual portion of gross sales which is taxable is expected to vary among the establishment groups. This variation depends upon not only the legislated tax base, but upon the buying habits of the purchasers in each of the establishment groups. Given that other things do not change, this relationship between total and taxable sales in each establishment group is expected to remain relatively constant.

Base Changes

A change in the tax base in any one of the regression groups can alter the relationship between gross sales and taxable sales in that group. For this reason it is necessary to include a variable to allow for the relationship to change whenever there is a legislated base change. As mentioned above, Appendix I includes a detailed description of the base changes that have occured in the various regression groups. Appendix I also includes a discussion of the manner in which the specification of this variable is made in each group. One should expect an increase in the tax base to increase that portion of gross sales which are taxable, in fact by definition that is the case. There is a distinct problem in the reporting of the data in the available sample, and the investigator should be prepared for the possibility that an increase in the base will appear to be a decrease in the effective rate.[9]

Quarterly Variation

Seasonal variation can also be expected to affect the relationship between gross and taxable sales. Specific reasons for the expectation of such seasonality may be found in such examples as the possibility that grocery stores may sell more beer and paper plates (both taxable) in the summer than during the balance of the year, and the possibility that the actual drugs sold by drug stores are a function of the 'cold and flu season' while relatively more cosmetics, cigarettes, and general health supplies (all taxable) are sold during the other months of the year. Consequently, one should expect the ratio of taxable to non-taxable sales in a number of regression groups to display seasonal variation.

The Form of the Equation

The taxable sales equation is a straightforward linear specification allowing for a constant relationship between taxable sales and gross sales. A complication arises in the form of shift variables for base changes as well as for seasonal variation.

Changes in the tax base are accounted for through the use of either an intercept shift variable, Base_{2i}, or a slope shift variable, $\text{Base}_{2i}(\text{GS})$, or possibly the two in concert. In the event that both of these variables have coefficients significantly different from zero, estimation of two sets of coefficients, one before and one after the base change will yield as much information as the use of dummy variables. Appendix I gives the significant estimated coefficients for the taxable sales equation.

The impact of quarterly variation also enters the specification through the use of dummy variables. These take the form of intercept shift variables, Q_1, or slope shift variables, Q_1(GS), with the possibility that the coefficients of both of these variables are significantly different from zero. In the instance that both are significantly different from zero, the use of these dummy variables would as before offer no gain, and the coefficients for the unique quarter could be estimated alone.

There is a problem in the estimation of the taxable sales equation using ordinary least squares (OLS) in that the error term and gross sales, an explanatory variable, are not expected to be independent of one another [7, p. 174]. This is caused by correlation of the error terms of equations (1) and (2). This leads to inconsistent OLS estimates, and the solution lies in two-stage least squares (2SLS) estimation of the structural coefficients.

The use of 2SLS entails the utilization of $\hat{G}$, the predicted value of gross sales, which nets out the residuals from the gross sales equation.[10] This modifies equation (2) so that

$$(18) \quad TS_i = \gamma + \delta_0 \hat{G}_i + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Base_{2i} + \varepsilon_{ti}$$

This specification allows for consistent estimates of δ_0, and offers the investigator insights into the actual effective sales tax rate in the various expenditure groups.[11] These significant estimated coefficients of equation (18) are presented in Appendix I.

The estimated coefficient $\hat{\delta}_0$ gives information regarding the impact of exemptions to the general sales tax on the specific regression groups. This information, in concert with the gross sales equation previously discussed, allows the investigator to move on to the tax revenue equation.

The Tax Revenue Equation

Once the taxable sales in a regression group have been determined, tax revenues should be easily computed through the use of the legislated tax rate as shown in equation (3):

(3) $TR_i = TS_i(Rate_i)$

A complication in this specification arises from the possibility that certain of the establishment groups sell various products that are taxable at different rates. An example is an automobile dealer who sells automobiles taxed at four percent as well as farm machinery taxed at three percent. Any establishment selling self-propelled or power-drawn farm equipment collects a three percent sales tax on such sales. At present these farm equipment sales are the only sales taxed at other than four percent (or altogether exempted). Over the period represented by the data used in this study, there were various establishment groups, including boat dealers and manufacturing equipment dealers, who experienced multiple tax rates. For these reasons the specification for the determination of tax revenues is

(19) $TR_i = rate_i(TS_i) + \varepsilon_{ri}$

where $rate_i$ is the estimated actual rate due on taxable sales in regression group i. The same problem arises in the estimation of equation (19) as arose in the estimation of equation (2). There is no confidence in the independence of the error terms in equations (19), (18), and (8). For this reason equation (19) is not expected to provide consistent estimates of $rate_i$. In order to obtain consistent estimates of $rate_i$, another equation must be stated:

(20) $TR_i = rate_i(\hat{T}_i) + \varepsilon_{ri}$

where $\hat{T}$ is the predicted value of taxable sales in the ith establishment group. This makes estimation of the coefficient $rate_i$ a 2SLS process in order to obtain consistent estimates. As all but those establishments selling self-propelled or power-drawn farm equipment can be properly represented by equation (3), the coefficients of equation (20) are not estimated in this dissertation.

Aggregation Over Establishment Groups

The fact that the relationship between income and gross sales is not linear is sufficient to cause inconsistent aggregation over the various establishment groups. As pointed out by Green [16, p. 40], the individual functions must be linear with identical slopes to avoid inconsistent aggregation.

The necessary conditions for consistent aggregation are that for all r, s, and t

(21) $\partial F/\partial x_r = \partial f_s/\partial x_{rs} = \partial f_t/\partial x_{rt}$

where F is the aggregate function and f_s and f_t are the micro functions. "The values of $\partial f_s/\partial x_{rs}$ must not only be equal for all s, but constant for all values of x_{rs} [16, p. 40]." In fact, the assumption of linearity need not be violated to lead to aggregation bias. The simple fact that the coefficients b_r in the function

(22) $GS = a + \sum_{r=1}^{n} b_r TS_r + u$

differ among establishment groups is reason enough to expect bias to appear. Such bias appears in the estimated aggregate coefficients in the form of covariance terms among the various micro coefficients [16, p. 100].

Continuing to call upon Green, he states:

> ... the purposes of the investigator are of course paramount, and he must weigh the errors he may believe likely to result from a high degree of aggregation against the cost of using a disaggregated model. [16, p. 99]

In the instance of Florida sales taxes, the costs of using disaggregated data are minimal. The data are readily available.

Summary

This chapter has been concerned with the specification of the structural model. Detailed explanation was made concerning the justification of each of the included variables. Also of concern in this chapter has been the actual estimation of the structural coefficients included in the appendix following Chapter IV. The information contained in this appendix offers the policy makers of the state of Florida information which has heretofore not been available. The focus in this dissertation is not strictly on taxable sales, but rather on gross sales in concert with what has been called the effective tax rate. This information allows the policy maker to investigate the impact of changes in income on both total sales and taxable sales in each of forty-four regression groups. Chapter IV deals with the information gleaned from the structural coefficients and the application of such information to policy problems confronting the state.

Notes

1. Although it can be argued that permanent income is the relevant variable, a proper measure of permanent income is difficult to obtain; therefore, current income is used in this study. If permanent income is the proper variable, this use of current income could result in an errors in variables problem leading to a slight downward bias in the estimated coefficients [15].

2. There is a problem involved in classification of entire establishment groups. Many establishment groups sell both 'necessities' and 'luxury goods', and the relative weights of these categories of goods are difficult, if not impossible, to determine.

3. The price deflator information was obtained from the data file of Data Resources, Incorporated.

4. The possibility exists that the purchaser can cross the state line in order to make his purchases, although the two bordering states also have sales taxes (three percent in Georgia and four percent in Alabama). In fact the state of Florida requires that if a Florida resident purchases an auto in another state he must either pay the state in which the purchase was made at least a four percent sales tax or pay the state of Florida the difference between the amount paid to the state in which the purchase was made and four percent of the selling price.

5. A _t_-test can be performed on the estimated coefficient for various levels of significance to determine the confidence that the investigator should have regarding the possibility that the estimated coefficient is not zero.

6. It should be pointed out that the levels of significance of the coefficients for the income and square of income variables are expected to be influenced by the very high degree of multicollinearity between these two variables [21, p. 160].

7. This is different from the standard approach of investigating the relationship between either tax revenues or taxable sales and personal income.

8. As mentioned in Chapter I a complete listing of exemptions is made in Chapter 12A-1.01 of _Rules And Regulations Florida Sales and Use Tax Law_ [13].

9. It is possible that a base change can require establishments previously not reporting sales to report their sales and thus cause an increase in the tax base to appear to decrease the percentage of sales which are taxable (or leave that percentage unaltered). See the discussion of the rate change variable in the gross sales equation earlier in this chapter.

10. The actual method used here is the two-stage least squares portion of the Econometric Software Package (ESP) as developed by J. Phillip Cooper of the University of Chicago Graduate School of Business.

11. The fact that most establishment groups make sales that are exempt from the sales tax leads to the situation that, although the sales tax rate is legislated at four percent, the actual amount due to the state in most groups is less than four percent of gross sales.

CHAPTER IV

APPLICATION OF THE STATISTICAL RESULTS

Introduction

This chapter draws together the salient points of the previous chapters and points out the significance of the work in the body of the dissertation. The research done here indicates that there are significant factors, heretofore not considered in the modeling of state sales tax revenues, that must be considered when specifying the sales tax model. It is the purpose of this chapter to discuss the important contributions of the model developed in Chapter III. This discussion is divided into two broad categories. In the first, the focus is upon the short run implications of the model. In the second category the concern is with the longer run implications.

Short Run Applications

In this dissertation there are two ingredients that strengthen short run modeling of state sales taxes. The first of these is the recognition of the need for a nonlinear income term. The second is knowledge of the fact that aggregation over various groups of products may well lead to biased estimates. For these reasons there is theoretical justification for the use of a disaggregated model which includes a nonlinear income term for short run forecasting of state sales tax revenues.[1]

These arguments indicate that the method presently employed by the state of Florida could be improved without great expense since the disaggregated data pertaining to gross and taxable sales are available from the Department of Revenue.

Longer Run Implications

The short run information discussed above is of major importance to the budget maker who is interested in forecasting six to eight quarters into the future. But the model presented in Chapter III makes information available that goes beyond the six to eight quarter time horizon.

Shifts Among Establishment Groups

The estimated structural coefficients from equation (8) reveal information about the makeup of gross sales that is useful in determining any shifts among regression groups. These results, presented in Table III, give information that has previously not been available concerning the expansion of gross sales with respect to the expansion of income. The expansion in the various establishment groups is at noticeably different rates. Group twenty-five, schools and educational institutions, is expanding slowly and its relative importance in the makeup of gross

TABLE III

FIRST AND SECOND DERIVATIVES WITH RESPECT TO INCOME AND INCOME ELASTICITY OF EACH REGRESSION GROUP

GROUP	$\partial GS_i/\partial Y \| Y=\bar{Y}^a$	$(\partial^2 GS_i/\partial Y^2)10^{-7}$	ELASTICITY (at $\overline{GS}_i$, $\bar{Y}$)	$\overline{GS}_i^b$
1	.10426	.0120	0.71609	666544
2	.06787	.0014	0.97016	320285
3	.02984	.0499	1.10505	123636
4	.10859	.0560	1.26179	394012
5	.04767	.0199	1.85445	117675
6	.04073	.0168	1.13201	164733
7	.22087	.9760	1.21348	833272
8	.03813	.1299	0.73341	238033
9^c	.01754	.0599	1.61968	49599
10	.06461	.0232	1.15520	256012
11	.02324	.0046	1.26240	84263
12	.00007	-.0002	2.51149	120
13	.01072	.0638	1.29472	37904
14	.15416	.3880	1.18774	594195
15	.00394	.0002	1.54109	11713
16	.00128	.0051	1.41862	4121
17	.00887	.0024	0.52514	77339
18	.06853	.0959	1.46979	213452
19	.01290	.0414	1.04473	56537
20	.00544	-.0143	1.58687	15700
21	.00233	-.0114	0.57723	18445
22	.00238	.0123	1.28886	8463
23	.01509	.0537	1.37499	50240
24	.02591	.0634	1.40274	84561
25	.00034	-.0052	0.81941	1914
26	.00923	-.0034	0.69819	60537
27	.02656	-.0023	0.67504	180168
28	.01434	.1959	0.55064	119197
29	.00196	-.0037	1.80006	4982
30	.06333	.0220	1.17819	246088

TABLE III CON'T

GROUP	$\partial GS_i/\partial Y \vert Y=\overline{Y}$[a]	$(\partial^2 GS_i/\partial Y^2)10^{-7}$	ELASTICITY (at $\overline{GS}_i$, $\overline{Y}$)	$\overline{GS}_i$[b]
31	.09557	.9680	0.82030	533385
32	.01014	-.0230	0.46932	98893
33	.00521	.0490	1.41394	16854
34	.00302	.0268	1.29842	10640
35	.01612	.0650	3.03491	24318
36	.04436	.1522	1.50588	134861
37	.21112	.4860	1.21521	795378
38	.09334	.6500	1.13173	377602
39	.02381	.0306	0.97861	111364
40	.00190	.0074	1.27552	6832
41	.00136	.0252	0.28557	21733
42	.02429	-.0872	2.51106	44277
43	.00151	.0444	0.17053	40660
44	.00532	.0368	0.66505	36659

a. $\overline{Y}$ = 4578202.

b. In thousands of dollars.

c. Group nine estimates are for quarter 2, 1970, through quarter 2, 1974, only.

sales is lessening. Alternatively, group fourteen, wholesale trade, is increasing rapidly in importance. These facts pertaining to the structure of the economy are entirely overlooked through the use of the reduced form forecasting equation which goes directly to the estimation of taxable sales.

Any comprehensive effort to model the Florida economy should concern itself with the makeup of total economic activity within the state. The results reported in Table III give the investigator the ability to forecast changes in the makeup of economic activity, and by giving this ability, these coefficients become a valuable new tool to those who are interested in the economic growth of the state.

The Effective Tax Rate

The information in Table IV makes up a major portion of the results of this dissertation. The effective tax rate $(.04\partial TS/\partial GS)$ informs the investigator as to how tax revenues from a specific regression group should be expected to change given a change in gross sales in that regression group. This information, used in concert with the information presented in Table III, gives information that has previously been unavailable. Specifically this is knowledge of the exact source of changes in tax revenues. Table V illustrates this point and shows that the makeup

TABLE IV

TAXABLE SALES AS A PART OF GROSS SALES AND EFFECTIVE TAX RATES

GROUP	$\partial TS/\partial GS$	$.04(\partial TS/\partial GS)$
1	.309668	.0123867
2	.916426	.0366570
3	.993540	.0397416
4	.934807	.0373922
5	.618094	.0247237
6	.563864	.0225545
7	.702135	.0280854
8	.171183	.0068473
9	.175395	.0070158
10	.713888	.0285555
11	.628227	.0251290
12	.869009	.0347603
13	.832893	.0333157
14	.121670	.0048668
15	.806080	.0322432
16	.486206	.0194482
17	.639788	.0255915
18	.748067	.0299226
19	.333638	.0133455
20	.235740	.0094296
21	.509158	.0203663
22	.307331	.0122932
23	.679385	.0271754
24	.836516	.0334606
25	.762969	.0305187
26	.264129	.0105651
27	.517644	.0207057
28	.678039	.0271215
29	.772191	.0308876
30	.624395	.0249758

TABLE IV CON'T

GROUP	$\partial TS/\partial GS$	$.04(\partial TS/\partial GS)$
31	.600694	.0240277
32	.688734	.0275493
33	.306294	.0122517
34	.456457	.0182582
35	.403056	.0161222
36	.422965	.0169186
37	.167367	.0066946
38	.064023	.0025609
39	.570778	.0228311
40	.243828	.0097531
41	.280941	.0112376
42	.301363	.0120545
43	.270675	.0108270
44	.568995	.0227598

TABLE V

THE MAKEUP OF TAX REVENUES

GROUP	PORTION OF TOTAL TAX DOLLAR: QUARTER 2, 1974	ESTIMATED PORTION OF MARGINAL TAX DOLLAR	REVENUE GENERATION COEFFICIENT
1	.0538519	.037604	.0012914
2	.0936287	.072471	.0024879
3	.0304455	.034546	.0011858
4	.1015766	.118260	.0040604
5	.0141214	.034342	.0011785
6	.0218938	.026769	.0009186
7	.1327030	.180682	.0062032
8	.0098394	.007602	.0002610
9	.0029142	.003583	.0001230
10	.0398598	.053742	.0018449
11	.0133143	.017011	.0005839
12	.0000061	.000699	.0000243
13	.0137918	.010399	.0003571
14	.0261573	.021846	.0007502
15	.0035858	.003699	.0001270
16	.0008256	.000728	.0000248
17	.0228488	.006612	.0002269
18	.0412215	.059742	.0020505
19	.0085702	.005010	.0001721
20	.0016727	.001486	.0000512
21	.0050983	.001369	.0000474
22	.0018083	.000845	.0000292
23	.0095929	.011943	.0004100
24	.0190627	.025254	.0008669
25	.0003296	.000291	.0000103
26	.0055728	.002855	.0000975
27	.0071007	.016021	.0005499
28	.0323801	.011331	.0003889
29	.0015033	.001748	.0000605
30	.0279595	.046081	.0015817

TABLE V CON'T

GROUP	PORTION OF TOTAL TAX DOLLAR: QUARTER 2, 1974	ESTIMATED PORTION OF MARGINAL TAX DOLLAR	REVENUE GENERATION COEFFICIENT
31	.1250847	.066878	.0022963
32	.0171866	.008127	.0002793
33	.0025414	.001864	.0000638
34	.0028279	.001602	.0000551
35	.0033547	.007573	.0002598
36	.0166629	.021875	.0007505
37	.0435905	.041158	.0014133
38	.0094050	.006962	.0002390
39	.0189302	.015846	.0005436
40	.0009673	.000553	.0000185
41	.0006592	.000437	.0000152
42	.0089768	.008535	.0002928
43	.0019777	.000466	.0000163
44	.004587	.003525	.0001210

of average tax revenues differs from the makeup of marginal tax revenues.

Table V points out that while only 1.41214 percent of the average dollar originates from sales by drug stores (group five), 3.4342 percent of the marginal tax dollar comes from sales by drug stores. Likewise, while 5.38519 percent of the average tax dollar comes from sales by establishments in the food store group (group one), only 3.7604 percent of the marginal tax dollar is from that source. Automobile dealers (group seven) contribute 13.2703 percent of the average tax dollar while contributing 18.0682 percent of the marginal tax dollar. Finally, sales by building contractors and suppliers (group thirty-one) account for 12.50847 percent of the average tax dollar while contributing only 6.6878 percent of the marginal tax dollar.

Also presented in Table V are what are referred to as the revenue generation coefficients of each of the regression groups. These coefficients represent the expected increase in tax revenue from sales in each of the regression groups associated with a one dollar increase in Florida personal income. As an example, if Florida personal income increases by one dollar, tax revenues generated by auto dealers (group seven) will increase by .0062032 dollars, and tax revenues generated by sales in grocery stores (group one) will increase by .0012914 dollars. The sum of the revenue generation coefficients for each of the regression groups is .034331. This indicates the amount ($.034331) by which total sales tax revenues should increase when Florida personal income increases by one dollar.

Changes in the Tax Base

The information presented and discussed above indicates that the actual makeup of the tax base is changing with changes in income. As displayed in Table III, the various regression groups change in different ways in response to changes in income. This fact, in conjunction with the information presented in Table IV indicating that the various regression groups have different taxable to gross sales ratios, points out that the various regression groups vary in their importance as revenue generators with changes in income.

Table VI points out the impact that these shifts in relative importance have had on the taxable to gross sales ratio over the forty-two quarter sample. In order to determine whether there is a trend of any kind evident in these data, Box-Jenkins univariate time series analysis is used. The results of this analysis indicate that this is a stationary series, and there is in fact no trend in the percentage of gross sales that are taxable.[2]

TABLE VI

TOTAL TAXABLE SALES AS A PERCENTAGE OF TOTAL SALES

YEAR	QUARTER	PERCENTAGE	YEAR	QUARTER	PERCENTAGE
1964	1	50.6401	1969	3	48.3572
1964	2	46.7113	1969	4	48.5129
1964	3	46.6586	1970	1	49.0590
1964	4	46.3234	1970	2	51.3592
1965	1	47.4663	1970	3	49.1303
1965	2	46.5344	1970	4	49.5405
1965	3	45.2555	1971	1	49.5949
1965	4	45.2741	1971	2	49.4869
1966	1	46.4077	1971	3	48.2995
1966	2	46.2675	1971	4	49.4938
1966	3	44.7428	1972	1	49.2617
1966	4	44.6335	1972	2	48.8708
1967	1	45.7961	1972	3	47.9049
1967	2	46.3313	1972	4	47.9036
1967	3	45.0603	1973	1	49.3627
1967	4	45.3551	1973	2	48.3501
1968	1	46.0407	1973	3	47.0793
1968	2	47.4458	1973	4	47.3746
1968	3	48.4018	1974	1	46.4346
1968	4	47.6689	1974	2	45.7354
1969	1	48.6948			
1969	2	48.7601	Mean		47.5615

The Florida Econometric Model

In addition to the revenue forecasting model of the Florida Department of Administration, the College of Business Administration of the University of Florida is in the process of developing a comprehensive econometric model of the state of Florida. The addition of equations similar to those developed in this dissertation would add substantial information-generating capacity to the present econometric model.

The Florida econometric model is presently being used to estimate taxable sales in five categories quite similar to the model of the Florida Department of Administration. This dissertation discusses reasons why this method of estimation deserves reconsideration. More important, the inclusion of a system of equations similar to those developed here would give the additional capacity to the model to forecast patterns of gross sales within the state's economy. The necessary input for such estimation is Florida personal income which the econometric model is presently being used to forecast.

Summary

This study is founded on a structural model of the Florida sales tax. The estimated coefficients yield information which has heretofore not been available. Structural shifts in the makeup of total sales and taxable sales are illustrated in the information presented in Table III, Table IV, and Table V.

Special care is taken to insure that the specification set forth here is as accurate as possible. It is felt that the contribution of this work should assist in the projection of future tax revenues, although the actual process of future revenue projection is not included in the scope of this work. The method of specification of the tax model and the theory on which it is founded, in conjunction with the information pertaining to structural shifts in Florida, should give useful information to interested administrators in the state.

Notes

1. The argument here is strictly theoretical, and there is no attempt to actually test empirically the forecasting power of the model. The reason for this failure to test the model lies in the fact that all available observations are used to estimate the coefficients presented in Appendix I. As additional observations become available, a test of the model should be carried out.

2. The information presented in Appendix III indicates that this ratio is a stationary series of a first-order autoregressive relationship. Mabert and Radcliffe [24] point out that this is shown by the fact that the autocorrelations reach zero in about twelve lags and then fluctuate close to zero for the remaining lags.

APPENDIX I

DISCUSSION OF EACH REGRESSION GROUP AND PRESENTATION OF REGRESSION RESULTS

These results are presented using the following symbols to represent the regressors:

GS_i = real gross sales in group *i*, measured in thousands of dollars,

TS_i = real taxable sales in group *i*, measured in thousands of dollars,

RFY = real Florida income, in thousands of dollars,

YSQ = the square of real Florida income,

QI_i = an intercept shift in quarter *i*,

QS_j = a change in slope in quarter *j*, using RFY for the gross sales equation and GS_i for the taxable sales equation,

BX(J) = a base change in group J affecting the slope, using RFY for the gross sales equation and GS_i for the taxable sales equation,

BXI(J) = a base change in group J affecting the intercept, and

Rate = a rate change.

Group One[1]

This group is made up of food products sold for use in the home. If this group were restricted to food sales in grocery stores one should expect the second order partial with respect to income (α'') to be negative. This expectation is complicated by the fact that grocery stores sell beer and wine as well as many household products. Also included in this regression group are bakeries, delicatessens, and candy stores. Sales by each of these establishments can reasonably be expected to react to changes in income in a manner not unlike the sales of various products sold by grocery stores. This group does not lead the investigator to have strong preconceived convictions concerning the sign of α''.

The gross sales regression results for group one are

$$GS1 = \underset{(67718.5)}{228178} + \underset{(.02977)}{.098766}(RFY) + \underset{(.0000000031)}{.0000000006}(YSQ)$$

$$- \underset{(.001854)}{.010540}(QS3) - \underset{(.001827)}{.014441}(QS4)$$

$R^2 = .9680$

$DW = 2.2554$

$F(4,37) = 279.661$

$S.E./\overline{GS} = .0340745$

The results of the taxable sales equation are

$$TS1 = \underset{(5647.13)}{-35304.5} + \underset{(.008598)}{.309668}(GS1) + \underset{(.000554)}{.001015}(QS2)$$

$$+ \underset{(.000557)}{.002811}(QS3) + \underset{(.000544)}{.000944}(QS4)$$

$R^2 = .9768$

$DW = 1.3273$

$F(4,37) = 389.838$

$S.E./\overline{TS} = .0349524$

These results show that the second order partial of gross sales with respect to income (the coefficient of YSQ multiplied by 2) is positive. The coefficients of the seasonal fluctuation variables are significantly different from zero in both equations.

Group Two

Group two consists of food and beverages consumed away from the home and α'' should be positive. The quarterly variation variables are expected to be extremely active in this group because of tourism.

The results of the gross sales regression are

$$GS2 = \underset{(40564.6)}{37406.6} + \underset{(.017833)}{.067270(RFY)} + \underset{(.00000000186)}{.000000000066(YSQ)}$$

$$- \underset{(.001111)}{.010040(QS3)} - \underset{(.001095)}{.014342(QS4)}$$

$R^2 = .9735$

$DW = 1.9320$

$F(4,37) = 339.806$

$S.E./\overline{GS} = .0424781$

The results of the taxable sales equation are

$$TS2 = \underset{(1365.21)}{8154.09} + \underset{(.004037)}{.916426(GS2)} - \underset{(.000153)}{.000374(QS4)}$$

$R^2 = .9993$

$DW = 1.6497$

$F(2,39) = 27287.7$

$S.E./\overline{TS} = .0066367$

The seasonal fluctuation variables for quarter three and four have significant coefficients in the gross sales equation. The taxable to gross sales relationship is significantly different from the rest of the year during quarter four.

Group Three

Apparel makes up the third group. The results of the application of the gross sales equation are

$$GS3 = \underset{(23845.4)}{123073} - \underset{(.010464)}{.006953}(RFY) + \underset{(.0000000011)}{.0000000025}(YSQ)$$

$$- \underset{(3407.78)}{12258.8}(QI2) - \underset{(3495.69)}{44368.2}(QI3) - \underset{(3493.89)}{40335.7}(QI4)$$

$R^2 = .9311$

$DW = 2.1947$

$F(5,36) = 97.2797$

$S.E./\overline{GS} = .0646196$

The results in the estimation of the taxable sales equation are

$$TS3 = \underset{(2856.18)}{-8932.24} + \underset{(.01985)}{.99354}(GS3) + \underset{(1254.43)}{4413.8}(QI3) + \underset{(1188.8)}{3201.92}(QI4)$$

$R^2 = .9917$

$DW = 1.3198$

$F(3,38) = 1521.41$

$S.E./\overline{TS} = .0221307$

In this group the significant shift variables for seasonal variation are in the form of intercept shifts.

Group Four

Group four is made up of department stores and other similar establishments. The results of the estimation of coefficients of the gross sales equation are as follows:

$$GS4 = \underset{(68123.1)}{6541.68} + \underset{(.029959)}{.083877(RFY)} + \underset{(.0000000031)}{.0000000028(YSQ)}$$

$$- \underset{(.002059)}{.01477(QS2)} - \underset{(.002138)}{.022623(QS3)} - \underset{(.002115)}{.014880(QS4)}$$

$$R^2 = .9691$$

$$DW = 2.6818$$

$$F(5,36) = 226.101$$

$$S.E./\overline{GS} = .0579873$$

The regression results for the taxable sales equation are

$$TS4 = \underset{(1035.68)}{3729.47} + \underset{(.002386)}{.934807(GS4)} - \underset{(.000154)}{.000672(QS2)}$$

$$- \underset{(.000162)}{.000366(QS3)} - \underset{(.000159)}{.000680(QS4)}$$

$$R^2 = .9998$$

$$DW = 1.7107$$

$$F(4,37) = 40868.5$$

$$S.E./\overline{TS} = .0048704$$

Group four has significant estimated coefficients associated with the quarterly change variables in both the gross and taxable sales equations.

Group Five

Group five, drug stores, should display seasonal fluctuation based on the cold and flu season and the influence of tourists. The second partial with respect to income should be positive founded on the fact that most drug stores sell a large number of products other than drugs such as records, radios, and cosmetics.

The results of the estimation of coefficients of the gross sales equation are

$$GS5 = \underset{(17260.2)}{-13843.8} + \underset{(.007591)}{.038512}(RFY) - \underset{(.0000000008)}{.0000000010}(YSQ)$$

$$- \underset{(.000522)}{.004592}(QS2) - \underset{(.000542)}{.007622}(QS3) - \underset{(.000536)}{.007308}(QS4)$$

R^2 = .9710

DW = 2.2872

F(5,36) = 241.193

$S.E./\overline{GS}$ = .0491937

Estimation of the coefficients of the taxable sales equation gave the following results:

$$TS5 = \underset{(1431.46)}{-7362.45} + \underset{(.010823)}{.618094}(GS5) - \underset{(.000181)}{.000880}(QS2)$$

$$- \underset{(.000192)}{.000625}(QS3) - \underset{(.000187)}{.000850}(QS4)$$

R^2 = .9899

DW = 1.7051

F(4,37) = 909.011

$S.E./\overline{TS}$ = .0338838

The significant estimated coefficients in this group do include those associated with the seasonal fluctuation variables. It is interesting to point out that α'' is negative for this group. This may reflect the fact that drugs make up a large portion of total sales of drugs stores and we may expect drug sales to be more a function of illness than of income.

Group Six

Auto parts and repair shops make up group six. The results of the estimation of the gross sales equation are

$$GS6 = \underset{(18390.1)}{141847} - \underset{(.008096)}{.036177}(RFY) + \underset{(.0000000009)}{.0000000084}(YSQ)$$

$$+ \underset{(.000521)}{.002402}(QS2) + \underset{(.000498)}{.001841}(QS3)$$

$$R^2 = .9886$$

$$DW = 1.4811$$

$$F(4,34) = 737.035$$

$$S.E./\overline{GS} = .0362196$$

The taxable sales equation results are

$$TS6 = \underset{(1187.65)}{-891.566} + \underset{(.006875)}{.563864}(GS6)$$

$$R^2 = .9946$$

$$DW = 2.2811$$

$$F(1,37) = 6864.82$$

$$S.E./\overline{TS} = .0242117$$

These regressions were run without including observations 26, 34, and 41 for quarters 2 of 1970, 2 of 1972, and 1 of 1974. These observations were excluded because of what appears to be errors in measurement. In the possibility that these three observations do not entail measurement errors the source of such wild fluctuations does not appear to be a factor that would lend itself to modeling.

Group Seven

This group, made up of sales by automobile dealers, is expected to have a positive second partial with respect to income. The results of the gross sales regression are

$$GS7 = \underset{(170178)}{736685} - \underset{(.074598)}{.218616}(RFY) + \underset{(.0000000078)}{.0000000488}(YSQ)$$

$$+ \underset{(20038.2)}{42932.2}(QI2)$$

R^2 = .9656

DW = 1.1094

F(3,38) = 355.758

S.E./$\overline{GS}$ = .0684565

The results of the taxable sales regression are

$$TS7 = \underset{(11132.6)}{-11695.8} + \underset{(.011325)}{.702135}(GS7) + \underset{(8982.96)}{19107.7}(QI2)$$

$$+ \underset{(9168.28)}{29184.8}(QI3) - \underset{(9175.98)}{18691.5}(QI4)$$

R^2 = .9909

DW = 1.7201

F(4,37) = 1011.10

S.E./$\overline{TS}$ = .0361202

Group Eight

Filling and service stations comprise group eight. The regression results of the gross sales equation are

$$GS8 = \underset{(54143)}{162109} - \underset{(.022691)}{.021380}(RFY) + \underset{(.0000000020)}{.0000000065}(YSQ)$$

$$+ \underset{(.002313)}{.009860}(BX8) - \underset{(.000939)}{.003710}(QI4)$$

R^2 = .9750

DW = 2.7673

F(4,36) = 350.462

S.E./$\overline{GS}$ = .0513496

where BX8 is a slope change for quarter 2, 1968, through quarter 2, 1974. The results of the taxable sales regression are

$$TS8 = \underset{(6129.17)}{7154.70} + \underset{(.024635)}{.171183}(GS8)$$

$$R^2 = .5965$$

$$DW = 2.2421$$

$$F(1,39) = 57.6575$$

$$S.E./\overline{TS} = .2351168$$

In these regressions observation 17, quarter 1 of 1968, is omitted because the observation is not consistent with those before it and the observation is adjacent to the quarter in which the base change appears to have occurred.

The base change variable is entered into the gross sales regression at the time of the major revisions that occurred to the sales tax system in 1968. The specific change relied upon here is the taxing of all fuels other than those on which highway taxes are imposed. This base change brought about the inclusion of kerosene and fuel oil and may well have caused dealers not previously reporting their sales to begin doing so.

Group Nine

Group nine is made up of aircraft dealers. The second partial of this group should be positive although these sales may not be explained by personal income as satisfactorily as various other groups. Inspection of the data in this group leads to recognition of complications in the specification of the gross sales equation. Apparently there was a change in reporting techniques in the first quarter of 1966 because from that point through 1974 the first quarter observations are noticeably higher than the balance of the year. As an explanation, any sales that are reported at the end of the year appear in quarter one as the sales data are reported one month late (see Appendix II). Also, beginning with the second quarter of 1970 there was a noticeable drop in gross sales in all quarters. This research has unearthed no reason for this decrease in reported sales. This drop has led the investigator to break the sample at the second quarter of 1970 regressing on not two but four variables for income. These were income and income squared before the break and income and income squared after the break. The results of the gross sales equation are

$$
\begin{aligned}
GS9 = {} & \underset{(54029.4)}{-110906} + \underset{(.028666)}{.068688(RFY^{1})} + \underset{(.019160)}{.045016(RFY^{2})} \\
& - \underset{(.0000000037)}{.0000000071(YSQ^{1})} - \underset{(.0000000017)}{.0000000030(YSQ^{2})} \\
& + \underset{(2029.75)}{15344.9(QS^{1})}
\end{aligned}
$$

$R^2 = .8406$

$DW = 1.6222$

$F(5,36) = 37.9571$

$S.E./\overline{GS} = .1055531$

where

RFY^1 = real Florida income quarter 1, 1964, through quarter 1, 1970,

RFY^2 = real Florida income quarter 2, 1970, through quarter 2, 1974,

YSQ^1 = real Florida income squared quarter 1, 1964, through quarter 1, 1970,

YSQ^2 = real Florida income squared quarter 2, 1970, through quarter 2, 1974, and

$QI1^1$ = an intercept shift term for quarter 1 from 1966 to 1974.

The results of the taxable sales regression are

$$TS9 = \underset{(1084.60)}{-2376.21} + \underset{(.024008)}{.175395}(DS9) - \underset{(657.378)}{2725.59}(QS1^1) + \underset{(396.879)}{2163.60}(I9)$$

R^2 = .7307

DW = 1.7376

F(3,38) = 34.3754

$S.E./\overline{TS}$ = .1852999

where

I9 = an intercept shift from quarter 2, 1970, through quarter 2, 1974, and

$QS1^1$ = a slope shift term for quarter 1 from 1966 to 1974.

Group Ten

Group ten is made up of sales by furniture stores, appliance stores, and music stores. Without question α'' should be positive in this group. The results of the gross sales equation are

$$GS10 = \underset{(54097.4)}{196741} - \underset{(.023739)}{.036097}(RFY) + \underset{(.0000000025)}{.0000000116}(YSQ)$$

$$- \underset{(7731.13)}{57057.9}(QI2) - \underset{(7930.56)}{42417.4}(QI3) - \underset{(7926.5)}{39365.7}(QI4)$$

$R^2 = .9654$

$DW = 1.5247$

$F(5,36) = 200.753$

$S.E./\overline{GS} = .0707978$

The significant estimated taxable sales coefficients are

$$TS10 = \underset{(3306.45)}{-4758.48} + \underset{(.012205)}{.713888}(GS10)$$

$R^2 = .9890$

$DW = 2.6839$

$F(1,40) = 3588.49$

$S.E./\overline{TS} = .0393727$

Group Eleven

Store and office equipment dealers make up group eleven. This group may leave quite a bit of variation unexplained because the attempt is made to explain sales by personal income. The hypothesis is that α'' will be positive. The significant estimated coefficients of the gross sales equation in group eleven are as follows:

$$GS11 = \underset{(19164.3)}{-11653.1} + \underset{(.008428)}{.021130}(RFY) + \underset{(.00000000088)}{.00000000023}(YSQ)$$

$$- \underset{(.000579)}{.001771}(QS2) - \underset{(.000601)}{.002166}(QS3) - \underset{(.000595)}{.001383}(QS4)$$

$R^2 = .9484$

$DW = 1.3773$

$$F(5,36) = 132.416$$

$$S.E./\overline{GS} = .0762792$$

The taxable sales equation for this group revealed

$$TS11 = \underset{(2816.9)}{-4390.20} + \underset{(.031995)}{.628227}(GS11)$$

$$R^2 = .9032$$

$$DW = .5272$$

$$F(1,40) = 373.070$$

$$S.E./\overline{TS} = .1089992$$

Group Twelve

Sales by holiday season vendors, group twelve, are definitely expected to reflect seasonal fluctuation. Inspection of the sales data for this group indicates that total sales have failed to increase very rapidly as incomes have increased. A major portion of this group is made up of Christmas Tree sales and a movement to artifical trees may be the reason for the lack of substantial growth in the area. The investigator has no strong preconceived notions concerning the sign of α'' for this group. The regression results of the gross sales equation are

$$GS12 = \underset{(128.927)}{-232.274} + \underset{(.000056)}{.000139}(RFY) - \underset{(.0000000000058)}{.0000000000084}(YSQ)$$

$$- \underset{(.000004)}{.000035}(QS2) - \underset{(.000004)}{.000038}(QS3) - \underset{(.000004)}{.000018}(QS4)$$

$$R^2 = .8254$$

$$DW = 1.9454$$

$$F(5,34) = 32.1478$$

$$S.E./\overline{GS} = .34356$$

The results of the taxable sales equation are

$$TS12 = \underset{(12.7749)}{-37.6935} + \underset{(.101229)}{.869009}(GS12)$$

$$R^2 = .8867$$

$$DW = 1.7861$$

$$F(1,38) = 297.447$$

$$S.E./\overline{TS} = .3715151$$

The seasonal fluctuation variables reflect the seasonal nature of this group. The value of α'' is in fact negative as reflected by the sign of the coefficients of the income squared term (recall $\alpha'' = 2\beta_6$).

Group Thirteen

Admissions make up group thirteen and α'' should be positive in this group. Based on tourism, the seasonal fluctuation variables should appear significant in this group. The opening of Walt Disney World in December 1971 may also have had an impact on gross sales in this group. The estimation of coefficients for the gross sales equation yielded the following results:

$$\begin{aligned} GS13 = {} & \underset{(14434.2)}{51323.2} - \underset{(.007143)}{.017664}(RFY) + \underset{(.00000000086)}{.00000000319}(YSQ) \\ & - \underset{(.004901)}{.017742}(WDWS) + \underset{(28261.5)}{113145}(WDWI) - \underset{(.000227)}{.000495}(QS2) \\ & - \underset{(.000234)}{.000450}(QS3) - \underset{(.000232)}{.002266}(QS4) \end{aligned}$$

$$R^2 = .9797$$

$$DW = 1.6050$$

$F(7,33) = 228.058$

$S.E./\overline{GS} = .06348$

where

WDWS = a slope change variable from quarter 2, 1972, through quarter 2, 1974, and

WDWI = an intercept change variable from quarter 2, 1972, through quarter 2, 1974.

The taxable sales regression results are

$$TS13 = \underset{(559.841)}{2724.51} + \underset{(.013166)}{.832893}(GS13) - \underset{(.000096)}{.000260}(QS4)$$

$R^2 = .9911$

$DW = 1.6459$

$F(2,38) = 2108.63$

$S.E./\overline{TS} = .0368944$

These regressions were carried out without the observation for quarter 1, 1972, because this was a transition quarter where the base changed. The observation did not appear to be consistent with the data either before or after the base change and for this reason it was deleted from the sample.

Group Fourteen

Group fourteen is made up of establishments making wholesale type sales. The results of the gross sales regression are

$$GS14 = \underset{(103993)}{286209} - \underset{(.045734)}{.019803}(RFY) + \underset{(.0000000048)}{.0000000194}(YSQ)$$

$$- \underset{(.003142)}{.006590}(QS2) - \underset{(.003263)}{.009189}(QS3) - \underset{(.003229)}{.014172}(QS4)$$

$R^2 = .9699$

$DW = .8643$

$$F(5,36) = 231.758$$

$$S.E./\overline{GS} = .0586977$$

For the taxable sales equation the results are

$$TS14 = \underset{(3474.42)}{-15557.4} + \underset{(.005713)}{.121670(GS14)} + \underset{(.000573)}{.001562(QS2)}$$

$$+ \underset{(.000593)}{.001331(QS3)} + \underset{(.000580)}{.002642(QS4)}$$

$$R^2 = .9376$$

$$DW = 1.8918$$

$$F(4,37) = 138.892$$

$$S.E./\overline{TS} = .1031433$$

Group Fifteen

Group fifteen, social clubs and associations, should have a positive second partial with respect to income. The results of the estimation of coefficients for the gross sales equation are

$$GS15 = \underset{(2358.28)}{-3851.85} + \underset{(.001037)}{.003833(RFY)} + \underset{(.000000000108)}{.000000000012(YSQ)}$$

$$- \underset{(.000071)}{.00356(QS2)} - \underset{(.000074)}{.000942(QS3)} - \underset{(.000073)}{.000735(QS4)}$$

$$R^2 = .9722$$

$$DW = 1.8729$$

$$F(5,36) = 251.567$$

$$S.E./\overline{GS} = .0675273$$

The taxable sales regression results are

$$TS15 = \underset{(264.169)}{-76.0266} + \underset{(.019393)}{.806080(GS15)} + \underset{(.000045)}{.000222(QS2)}$$

$$- \underset{(.000047)}{.000177(QS3)} + \underset{(.000046)}{.000216(QS4)}$$

R^2 = .9831

DW = 1.5982

F(4,37) = 539.230

S.E./$\overline{TS}$ = .0540917

Group Sixteen

Itinerant vendors make up group sixteen. Lack of knowledge concerning the complete list of individual establishments that make up this group makes any hypothesis concerning α'' difficult. One may well expect that a large portion of the sales made by such establishments are seasonal. For this reason the seasonal fluctuation variables are expected to be significant in this group. The results of the regression for the gross sales equation are

$$\underset{}{GS16} = \underset{(1142.67)}{2999.58} - \underset{(.000498)}{.001012}(RFY) + \underset{(.000000000052)}{.000000000256}(YSQ)$$

R^2 = .9564

DW = 1.3535

F(2,38) = 416.779

S.E./$\overline{GS}$ = .0890966

The results of the taxable sales regression are

$$TS16 = \underset{(55.8949)}{744.633} + \underset{(.012565)}{.486206}(GS16) + \underset{(.000010)}{.000018}(QS4)$$

R^2 = .9770

DW = 1.2303

F(2,38) = 808.515

S.E./$\overline{TS}$ = .0479077

It is interesting to note that the seasonal fluctuation variables are not significant in the gross sales regression.

Group Seventeen

Communications, group seventeen, is expected to have a positive second partial with respect to income. This group may also display the impact of a base change in the second quarter of 1968 because at that time a four percent tax was imposed in intrastate telephone and telegraphic charges. This change may have altered the total sales figures which were reported in this group. The results of the gross sales regression for this group are

$$\begin{array}{llll} GS17 = & -21894.5 & + .007864(RFY) & + .00000000012(YSQ) \\ & (17056.8) & (.007222) & (.00000000068) \\ & + .020486(BX17^{1}) & + .01338(BX17^{2}) & \\ & (.000712) & (.000870) & \end{array}$$

$$\begin{array}{ll} R^2 & = .9963 \\ DW & = 1.9674 \\ F(4,36) & = 2426.84 \\ S.E./\overline{GS} & = .0519 \end{array}$$

where

$BX17^{1}$ = a slope change for quarter 3, 1968, through quarter 3, 1973, and

$BX17^{2}$ = a slope change for quarter 4, 1973, through quarter 2, 1974.

The taxable sales regression yielded the following:

$$\begin{array}{llll} TS17 = & -1024.34 & + .639788(GS17) & - 37403(BXI17) \\ & (2428.71) & (.029183) & (4354.65) \end{array}$$

$R^2 = .9294$

$DW = .6870$

$F(2,38) = 250.215$

$S.E./\overline{TS} = .23945$

where BXI17 is an intercept shift to account for the fact that sales taxes were removed from residential telephone and telegraph services in the second quarter of 1972. These regressions are carried out omitting the observation for the second quarter of 1968. This observation is omitted because it is the quarter in which the new base, as represented by $BX17^1$, came into effect and the observation is not consistent with either set of data.

The variable $BX17^2$ is included because the last three observations of the gross sales data are substantially lower than those observations preceeding it. There have been no theoretical grounds discovered to justify the inclusion of this variable although the change in gross sales is significant in these observations.

Group Eighteen

Group eighteen consists of hotels and apartment houses. There was a major base change in this group in the second quarter of 1972. At that time the sales tax was eliminated on lodging facilities that rent primarily to persons as their principal or permanent place of residence. The regression results in the gross sales equation in this group are

$$GS18 = \underset{(86404.2)}{76601.1} + \underset{(.042262)}{.024581}(RFY) + \underset{(.0000000050)}{.0000000048}(YSQ)$$

$$- \underset{(.036605)}{.068090}(BX18) + \underset{(.221356)}{284514}(BXI18) - \underset{(.001529)}{.005867}(QS2)$$

$$- \underset{(.001534)}{.017110}(QS3) - \underset{(.001504)}{.023999}(QS4)$$

R^2 = .9430

DW = 1.9551

F(7,33) = 77.9378

S.E./$\overline{GS}$ = .0757294

where

BX18 = a slope change from quarter 3, 1972, through quarter 2, 1974, and

BXI18 = an intercept change from quarter 3, 1972, through quarter 2, 1974.

The taxable sales regression results are

$$TS18 = \underset{(4324.09)}{19190.8} + \underset{(.017054)}{.748067}(GS18) + \underset{(.009266)}{.010111}(BX18)$$

$$- \underset{(58922.2)}{42001.5}(BXI18) - \underset{(.000462)}{.002816}(QS3) - \underset{(.000507)}{.005029}(QS4)$$

R^2 = .9925

DW = 2.1103

F(5,35) = 922.459

S.E./$\overline{TS}$ = .0286024

The base change variables are significant in the gross sales equation. Although these base change variables do not appear to be significant in the taxable sales equation, their inclusion improves the Durbin-Watson and the standard error as a percentage of the mean when included among the regressors.

These coefficients are estimated without the inclusion of the observation from the second quarter of 1972. The transition between the two tax bases took place during this quarter and the observation is not similar to those observations preceding or following the change.

Group Nineteen

Graphic arts, printing, and advertising make up this group. Estimation of the gross sales equation yielded the following results:

$$
\begin{aligned}
GS19 = {} & \underset{(7933.18)}{37224.1} - \underset{(.003488)}{.005410}(RFY) + \underset{(.00000000036)}{.00000000207}(YSQ) \\
& - \underset{(.000217)}{.001217}(QS3) - \underset{(.000214)}{.000765}(QS4)
\end{aligned}
$$

R^2 = .9769

DW = 1.2101

$F(4,37)$ = 391.010

$S.E./\overline{GS}$ = .0470617

Estimation of the taxable sales equation yields

$$
TS19 = \underset{(727.917)}{1025.74} + \underset{(.012422)}{.333638}(GS19)
$$

R^2 = .9519

DW = 1.8971

$F(1,40)$ = 790.967

$S.E./\overline{TS}$ = .065171

Group Twenty

Group twenty is made up of establishments selling medical and dental services. The results of the gross sales regression are

$$GS20 = \underset{(4888.84)}{-19682.6} + \underset{(.002113)}{.011943}(RFY) - \underset{(.000000000200)}{.000000000713}(YSQ)$$

$$- \underset{(820.442)}{6205.43}(RATE) - \underset{(.000078)}{.000257}(QS2)$$

$$R^2 = .9384$$

$$DW = 1.1238$$

$$F(4,36) = 137.099$$

$$S.E./\overline{GS} = .0666554$$

where RATE is 0 in quarter 1, 1964, through quarter 1, 1968, and 1 in quarter 2, 1968, through quarter 2, 1974. The estimation of the coefficients of the taxable sales equation yields the following:

$$TS20 = \underset{(264.006)}{-962.299} + \underset{(.020512)}{.23574}(GS20) + \underset{(.000029)}{.000208}(BX20)$$

$$R^2 = .9496$$

$$DW = 1.0027$$

$$F(2,38) = 358.030$$

$$S.E./\overline{TS} = .096516$$

where BX20 is a slope change in quarter 2, 1968, through quarter 2, 1974. These coefficients are computed without inclusion of observation 17, quarter 1, 1968. That quarter is adjacent of the major changes which occurred in April of 1968 and the observation fails to be consistent with the data either before or after the change. The rate change variable is significant in the gross sales equation. There was also a base change in the second quarter of 1968 as is indicated by the significance of the base change variable in the taxable sales equation.

Group Twenty-one

Group twenty-one is made up of transportation services. The results of the gross sales regression are as follows:

$$\underset{(6334.20)}{GS21 = -3022.02} + \underset{(.002780)}{.007453(RFY)} - \underset{(.00000000029)}{.00000000057(YSQ)}$$

R^2 = .5840

DW = 1.1202

F(2,39) = 27.3745

S.E./$\overline{GS}$ = .1153158

The taxable sales regression yielded the following results:

$$\underset{(2235.14)}{TS21 = -470.302} + \underset{(.120143)}{.509158(GS21)}$$

R^2 = .2519

DW = 0.6919

F(1,40) = 13.4656

S.E./$\overline{TS}$ = .2119523

These results are less than satisfactory but all efforts to improve the specification failed.

Group Twenty-two

Group twenty-two is made up of insurance sales. Inspection of the available data indicates that there was a change in reporting techniques in quarter 1, 1970. At that time and continuing throughout the sample the value of the quarter one observation is substantially greater than the value of the observations in the other three quarters. The results of the gross sales regression are

$$GS22 = \underset{(2049.30)}{6850.41} - \underset{(.000899)}{.003202}(RFY) + \underset{(.000000000094)}{.000000000617}(YSQ)$$

$$+ \underset{(.000062)}{.003748}(BX22)$$

$R^2 = .9942$

$DW = 2.3180$

$F(3,38) = 2176.23$

$S.E./\overline{GS} = .0811876$

where BX22 is an intercept shift for quarter 1, applied to the years 1970 through 1974. The results of the taxable sales regression are

$$TS22 = \underset{(287.318)}{1691.69} + \underset{(.023859)}{.307331}(GS22)$$

$R^2 = .8006$

$DW = 1.9172$

$F(1,40) = 160.614$

$S.E./\overline{TS} = .3085744$

Group Twenty-three

This group is made up of sales by motor boat and yacht dealers. The results of the gross sales regression are

$$GS23 = \underset{(18878.2)}{24177} - \underset{(.008293)}{.008716}(RFY) + \underset{(.000000000867)}{.000000002686}(YSQ)$$

$$+ \underset{(.000496)}{.002866}(QS2) + \underset{(.000521)}{.002487}(QS3)$$

$R^2 = .9319$

$DW = 1.1991$

$F(4,37) = 126.675$

$S.E./\overline{GS} = .1260426$

The estimation of the taxable sales equation yields

$$TS23 = \underset{(513.317)}{-2139.53} + \underset{(.009360)}{.679385}(GS23)$$

$R^2 = .9930$

$DW = 1.6885$

$F(1,40) = 5662.14$

$S.E./\overline{TS} = .0417008$

Group Twenty-four

Specialty shops make up group twenty-four and the second partial with respect to income in this group is expected to be positive. The results of the estimation of coefficients in the gross sales equation are

$$GS24 = \underset{(12654.2)}{48568.6} - \underset{(.005565)}{.002474}(RFY) + \underset{(.00000000058)}{.00000000317}(YSQ)$$

$$- \underset{(.000382)}{.004924}(QS2) - \underset{(.000397)}{.008048}(QS3) - \underset{(.000393)}{.007796}(QS4)$$

$R^2 = .9835$

$DW = 1.3917$

$F(5,36) = 430.470$

$S.E./\overline{GS} = .0501898$

The estimation of the taxable sales equation yields

$$TS24 = \underset{(991.880)}{-3729.39} + \underset{(.010690)}{.836516}(GS24) - \underset{(.000160)}{.000972}(QS2)$$

$$- \underset{(.000165)}{.000316}(QS4)$$

$R^2 = .9940$

$DW = 1.4084$

$F(3,38) = 2109.43$

$S.E./\overline{TS} = .0316262$

Group Twenty-five

Schools and educational institutions make up group twenty-five. Because of the nature of the school year this group should display seasonal variation. The results of the gross sales regression are

$$GS25 = \underset{(1130.08)}{-4231.67} + \underset{(.000496)}{.002723}(RFY) - \underset{(.00000000005)}{.00000000026}(YSQ)$$

$$- \underset{(161.502)}{812.046}(QI2) - \underset{(165.668)}{1600.74}(QI3) + \underset{(165.583)}{315.690}(QI4)$$

R^2 = .8501

DW = 1.6638

F(5,36) = 40.8426

S.E./$\overline{GS}$ = .1978109

The results of the taxable sales regression are

$$TS25 = \underset{(102.289)}{-292.899} + \underset{(.043615)}{.762969}(GS25) + \underset{(.85.4963)}{200.134}(QS3)$$

R^2 = .9330

DW = 2.0701

F(2,39) = 271.594

S.E./$\overline{TS}$ = .1356817

Group Twenty-six

Industrial supplies and packaging make up this group. The results of the gross sales equation are

$$GS26 = \underset{(12389.8)}{13785.7} + \underset{(.005437)}{.010697}(RFY) - \underset{(.00000000057)}{.00000000017}(YSQ)$$

$$+ \underset{(.000307)}{.001213}(QS2)$$

R^2 = .8887

DW = 0.6596

$$F(3,38) = 101.155$$

$$S.E./\overline{GS} = .0686983$$

The taxable sales regression yields

$$TS26 = \underset{(1098.11)}{-3672.69} + \underset{(.017838)}{.264129}(GS26)$$

$$R^2 = .8321$$

$$DW = 0.5945$$

$$F(1,40) = 198.224$$

$$S.E./\overline{TS} = .1049225$$

Group Twenty-seven

Group twenty-seven is made up of sales by fuel dealers. The base change that occurred in the second quarter of 1968 is expected to have an impact on the gross sales equation in this group. This change entailed the taxing of all fuels except gasoline and other fuels on which highway taxes are imposed. The results of the gross sales regression are

$$GS27 = \underset{(76414.3)}{889.415} + \underset{(.032011)}{.027574}(RFY) - \underset{(.000000002884)}{.000000000115}(YSQ)$$

$$+ \underset{(.003336)}{.018458}(BX27) - \underset{(.001596)}{.002647}(BQ3) - \underset{(.001571)}{.003754}(BQ4)$$

$$R^2 = .9569$$

$$DW = 2.0728$$

$$F(5,35) = 155.346$$

$$S.E./\overline{GS} = .0958699$$

where

BX27 = a slope change for the base change occurring in the second quarter of 1968, BQ3 = a slope change for quarter three after the base change, and

BQ4 = a slope change for quarter four after the base change.

The taxable sales regression yields the following:

$$\begin{aligned} TS27 = {} & \underset{(17415.5)}{-39692.9} + \underset{(.184900)}{.517644}(GS27) - \underset{(.010938)}{.019804}(BX27) \\ & + \underset{(32468.0)}{70883.6}(BXI27) = \underset{(.001284)}{.001831}(BQ3) + \underset{(.001159)}{.000731}(BQ4) \\ & - \underset{(.020478)}{.034079}(BX272) + \underset{(107975)}{148892}(BXI272) \end{aligned}$$

$$\begin{aligned} R^2 &= .8771 \\ DW &= 1.6832 \\ F(7,32) &= 32.6132 \\ S.E./\overline{TS} &= .2705696 \end{aligned}$$

where

BXI27 = an intercept change quarter 2, 1968, through quarter 1, 1972,

BX272 = a slope change quarter 3, 1972, through quarter 2, 1974, and

BXI272 = an intercept change quarter 3, 1972, through quarter 2, 1974.

These regressions are run omitting the observation for the first quarter of 1968. This observation is adjacent to the quarter in which the base change took place and is apparently affected by the base change as the observation is not consistent with the balance of the data preceding the base change. The taxable sales equation in this group is run omitting the observation for the second quarter of 1972. The base changed during the second quarter of 1972, exempting sales taxes on all fuel for household use. This base change does not appear to be significant in the taxable to gross sales ratio.

Group Twenty-eight

This group is made up of office and commercial rentals. This is one of three groups that became taxable in the major base and rate changes of quarter 2, 1968, and for that reason the number of observations is less than most of the regression groups. The first observation, quarter 2, 1968, is omitted because taxes were due only two of the three months of the quarter and therefore the observation is biased. The results of the gross sales regression are

$$\underset{}{GS28} = \underset{(160674)}{229564} - \underset{(.059906)}{.075392}(RFY) + \underset{(.0000000055)}{.0000000098}(YSQ) + \underset{(5744.93)}{18224.1}(QI1)$$

R^2 = .8511

DW = 1.6475

F(3,20) = 38.1189

S.E./$\overline{GS}$ = .1019505

The results of the taxable sales regression are

$$TS28 = \underset{(5098.88)}{15388.7} + \underset{(.041756)}{.678039}(GS28)$$

R^2 = .9270

DW = 1.6280

F(1,22) = 279.339

S.E./$\overline{TS}$ = .0564008

Group Twenty-nine

Parking lots and boat docking and storage make up group twenty-nine, a group of services that became taxable with the base change of April 1968. Although data are available for quarter 2, 1968, the first observation is omitted because these sales were taxable in only two of three months in that quarter. The results of the gross sales regression are

$$GS29 = \underset{(4094.5)}{-8908.86} + \underset{(.001525)}{.003607}(RFY) - \underset{(.000000000140)}{.000000000187}(YSQ)$$

$$+ \underset{(.000028)}{.000078}(QS2) - \underset{(.000029)}{.000088}(QS4)$$

R^2 = .9564

DW = 1.9082

F(4,19) = 104.306

S.E./$\overline{GS}$ = .0619721

The results of the taxable sales regression are

$$TS29 = \underset{(64.3327}{537.289} + \underset{(.012264)}{.772191}(GS29) - \underset{(.000007)}{.000026}(QS3)$$

R^2 = .9950

DW = 1.9010

F(2,21) = 2109.89

S.E./$\overline{TS}$ = .0177676

Group Thirty

Utilities make up group thirty. This group became taxable with the base change that took place in April of 1968. The first observation, quarter 2, 1968, is omitted from these regressions because in this quarter, collections were made in only two of the three months. In March of 1972 there was a base change that removed the sales tax on electricity and artifical gas sold for residential use by utilities who are required to pay the gross receipts tax under Chapter 203. The results of the gross sales equation are

$$GS30 = \underset{(318673)}{-69378.1} + \underset{(.118601)}{.052009}(RFY) + \underset{(.0000000109)}{.0000000011}(YSQ)$$

$$- \underset{(.002495)}{.000999}(QS2) + \underset{(.002575)}{.002078}(QS3) + \underset{(.002547)}{.000451}(QS4)$$

R^2 = .8518

DW = 1.0843

$F(5,18)$ = 20.6983

S.E./$\overline{GS}$ = .0974049

The taxable sales regression results are

$$TS30 = \underset{(24631)}{46222.1} + \underset{(.116687)}{.624395}(GS30) - \underset{(12192.3)}{143512}(BXI30)$$

R^2 = .9354

DW = 1.9465

$F(2,20)$ = 144.890

S.E./$\overline{TS}$ = .0854502

where BXI30 is an intercept change for observations after quarter 2, 1972. Based on these results the base change of 1972 is significant in determining taxable sales. The taxable sales regression is carried out without inclusion of the quarter 1, 1972, observation. This observation is omitted because it is adjacent to the quarter in which the base change took place and the observation is inconsistent with the balance of the data.

Group Thirty-one

This group is made up of establishments selling building supplies as well as building contractors. The results of the gross sales regression for this group are

$$\underset{}{GS31} = \underset{(95801.8)}{1022520} - \underset{(.042038)}{.343915}(RFY) + \underset{(.0000000044)}{.0000000484}(YSQ)$$

$$+ \underset{(.002376)}{.005577}(QS2)$$

R^2 = .9586

DW = 0.8896

F(3,38) = 293.058

S.E./$\overline{GS}$ = .0602881

The results of the taxable sales regression are

$$TS31 = \underset{(4799.07)}{-35086.3} + \underset{(.008673)}{.600694}(GS31)$$

R^2 = .9919

DW = 1.4920

F(1,39) = 4883.34

S.E./$\overline{TS}$ = .0289854

Group Thirty-two

This group is made up of establishments that deal in hardware, paint, and light machinery. There was a change in the tax base in the second quarter of 1968 that should affect this group. At that time a flat rate tax of three percent was imposed on industrial machinery, removing the previous $5,000 limitation. Also, the data indicate that there was a change in gross sales between the final quarter of 1971 and the first quarter of 1972, although no reason can be located for such a change. The results of the estimation of the gross sales equation are

$$GS32 = \underset{(32087.2)}{25641.1} + \underset{(.015723)}{.020605}(RFY) - \underset{(.00000000191)}{.00000000115}(YSQ)$$

$$- \underset{(.000992)}{.001416}(BX32^1) + \underset{(.010276)}{.044471}(BX32^2) - \underset{(55288.1)}{248359}(BXI32)$$

$R^2 = .9612$

$DW = 1.2977$

$F(5,35) = 173.244$

$S.E./\overline{GS} = .0523314$

where

$BX32^1$ = a slope change quarter 2, 1968, through quarter 4, 1971,

$BX32^2$ = a slope change quarter 1, 1972, through quarter 2, 1974, and

BXI32 = an intercept change quarter 1, 1972, through quarter 2, 1974.

The results of the taxable sales equation are

$$TS32 = \underset{(1919.78)}{-5980.61} + \underset{(.018784)}{.688734}(GS32) + \underset{(.000218)}{.000396}(QS4)$$

$R^2 = .9734$

$DW = 0.5849$

$F(2,38) = 695.419$

$S.E./\overline{TS} = .0458031$

The base change that occurred in the second quarter of 1968 appears to have upset the reporting during that quarter because that observation is not consistent with the surrounding observations. For this reason the observation for quarter 2, 1968, is omitted from the sample.

In the gross sales equation the intercept shift coefficient as well as the slope shift coefficient are significant in the quarters between quarter 1, 1972, and quarter 2, 1974. This indicates that the relationship between income and gross sales in group thirty-two completely changed at that point in time.

Group Thirty-three

Group thirty-three is made up of top soil, clay, and fill dirt dealers. Inspection of the data reveals what is undoubtedly a reporting error in this group for quarter 2, 1969. The reported taxable sales figure for that quarter is far more than double the figure in the same quarter in both the preceding and following years. The results reported here exclude the quarter 2, 1969, observation. The estimated coefficients for the gross sales equation are

$$GS33 = \underset{(6020.42)}{38536.1} - \underset{(.002646)}{.016769(RFY)} + \underset{(.00000000028)}{.00000000245(YSQ)}$$

$$- \underset{(.000152)}{.000300(QS2)}$$

$$\begin{aligned} R^2 &= .9502 \\ DW &= 0.3515 \\ F(3,37) &= 235.430 \\ S.E./\overline{GS} &= .1180344 \end{aligned}$$

The taxable sales equation yields

$$TS33 = \underset{(118.646)}{-125.721} + \underset{(.006322)}{.306294(GS33)}$$

$$\begin{aligned} R^2 &= .9847 \\ DW &= 1.4500 \end{aligned}$$

$F(1,39) = 2507.51$

$S.E./\overline{TS} = .0663603$

Group Thirty-four

This group is made up of nurseries and landscaping. Inspection of base and rate changes in this group reveals two base changes, one occurring in July 1971, the other in June 1973. The July 1971 change enlarged the base to cover ornamental nursery stock sold by the producer to the final user. The June 1973 change defined nurseryman to be a person engaged in the production of nursery stock or horticultural plants. This 1973 change is to prevent nurserymen from claiming that their sales are in fact farm products and therefore exempt.

The results of the gross sales regression, exempting the transition quarter for both base changes, are as follows:

$$\underset{}{GS34} = \underset{(9688.64)}{19307.4} - \underset{(.004807)}{.008885(RFY)} + \underset{(.00000000059)}{.00000000134(YSQ)}$$

$$+ \underset{(.000371)}{.001242(BX34^1)} + \underset{(.000539)}{.001205(BX34^2)} + \underset{(.000155)}{.000537(QS2)}$$

$R^2 = .9505$

$DW = 2.5548$

$F(5,34) = 130.492$

$S.E./\overline{GS} = .1810782$

where

$BX34^1$ = a slope change quarter 4, 1971, through quarter 1, 1973, and

$BX34^2$ = a slope change quarter 3, 1973, through quarter 2, 1974.

The taxable sales regression, also excluding quarter 3, 1971, and quarter 2, 1973, yields the following:

$$\begin{array}{llll} TS34 = & -1093.88 & + .456457(GS34) & + .000182(QS4) \\ & (303.890) & (.022843) & (.000085) \end{array}$$

R^2 = .9308

DW = 2.3612

F(2,37) = 248.839

$S.E./\overline{TS}$ = .2763737

Group Thirty-five

Group thirty-five is made up of machine shops and foundries. Sales in this group could have been influenced by the base change of quarter 2, 1968, that imposed a three percent flat rate tax on industrial machinery and equipment. The results of the gross sales regression are

$$\begin{array}{llll} GS35 = & 24978.5 & - .013178(RFY) & + .00000000325(YSQ) \\ & (13487.9) & (.007274) & (.00000000102) \\ & - .013809(BX35) & + 52318.9(BXI35) & \\ & (.004430) & (18794.4) & \end{array}$$

R^2 = .9221

DW = 0.8487

F(4,36) = 106.513

$S.E./\overline{GS}$ = .0947195

where

BX35 = a slope change quarter 3, 1968, through quarter 2, 1974, and

BXI35 = an intercept change quarter 3, 1968, through quarter 2, 1974.

The taxable sales regression yields the following results:

$$TS35 = \underset{(363.619)}{772.231} + \underset{(.014717)}{.40056}(GS35) + \underset{(.000055)}{.000176}(QS2) + \underset{(.000055)}{.000150}(QS4)$$

$R^2 = .9614$

$DW = 1.2411$

$F(3,37) = 307.336$

$S.E./\overline{TS} = .0620145$

These regressions are estimated without the quarter 2, 1968, observation. That observation appears to have experienced a measurement problem because of the base change that occurred at that time. It is interesting to note that the intercept and slope change variables are both significant in the gross sales equation, indicating that the relationship between income and gross sales did change significantly during the second quarter of 1968. In fact the quarter 3, 1968, through quarter 2, 1974, coefficients could be estimated separately without any loss of information.

Group Thirty-six

This group is made up of industrial machinery and equipment, a group that experienced a base change in the second quarter of 1968. The results of the gross sales equation are

$$GS36 = \underset{(36834)}{87291.5} - \underset{(.016193)}{.025225}(RFY) + \underset{(.00000000169)}{.00000000761}(YSQ)$$

$$- \underset{(.001009)}{.003065}(QS3) - \underset{(.000994)}{.002745}(QS4)$$

$R^2 = .9555$

$DW = 1.4677$

$F(4,37) = 198.618$

$S.E./\overline{GS} = .0916039$

The results of the taxable sales regression are

$$TS36 = \underset{(2534.41)}{-6693} + \underset{(.017354)}{.422965}(GS36) + \underset{(.000457)}{.001145}(QS4)$$

$R^2 = .9402$

$DW = 1.2008$

$F(2,39) = 306.857$

$S.E./\overline{TS} = .1167882$

The base change mentioned above does not appear to have any impact on the gross sales equation. The insignificant coefficients are not presented.

Group Thirty-seven

Manufacturing and mining make up group thirty-seven. This group, because of the nature of the product, may not be well explained by personal income. The results of the gross sales equation are

$$GS37 = \underset{(180312)}{328923} - \underset{(.079268)}{.008615}(RFY) + \underset{(.000000083)}{.0000000243}(YSQ)$$

$$- \underset{(.004937)}{.008673}(QS3) - \underset{(.004866)}{.023110}(QS4)$$

$R^2 = .9516$

$DW = 1.2282$

$F(4,37) = 181.751$

$S.E./\overline{GS} = .0760331$

The taxable sales regression results are

$$TS37 = \underset{(6386.23)}{-42528.5} + \underset{(.007777)}{.167367}(GS37) + \underset{(.001074)}{.002471}(QS2)$$

$$+ \underset{(.001107)}{.002430}(QS3) + \underset{(.001074)}{.003867}(QS4)$$

R^2 = .9386

DW = 1.7266

F(4,37) = 141.346

S.E./$\overline{TS}$ = .1205793

Group Thirty-eight

Rental of tangible property makes up group thirty-eight and the gross sales results are

$$GS38 = \underset{(89470.1)}{560349} - \underset{(.039260)}{.199645}(RFY) + \underset{(.0000000041)}{.0000000325}(YSQ) + \underset{(.002219)}{.005692}(QS2)$$

R^2 = .9563

DW = 1.8906

F(3,38) = 277.342

S.E./$\overline{GS}$ = .0795321

The taxable sales regression yields

$$TS38 = \underset{(394.586)}{1459.26} + \underset{(.000987)}{.064023}(GS38) + \underset{(.000066)}{.000149}(QS3)$$

R^2 = .9914

DW = 1.4664

F(2,39) = 2239.25

S.E./$\overline{TS}$ = .0330118

Group Thirty-nine

Group thirty-nine is made up of various personal services such as barbers, florists, and laundries. The gross sales equation yields the following results:

$$\begin{aligned} GS39 = {} & \underset{(19953.2)}{36295.8} + \underset{(.008772)}{.010072}(RFY) + \underset{(.00000000092)}{.00000000153}(YSQ) \\ & - \underset{(.000546)}{.002478}(QS3) - \underset{(.000538)}{.002243}(QS4) \end{aligned}$$

$$\begin{aligned} R^2 &= .9510 \\ DW &= 0.8310 \\ F(4,37) &= 179.683 \\ S.E./\overline{GS} &= .0600926 \end{aligned}$$

The taxable sales equation results are

$$TS39 = \underset{(1784.31)}{-2652.83} + \underset{(.015549)}{.570778}(GS39)$$

$$\begin{aligned} R^2 &= .9714 \\ DW &= 0.6822 \\ F(1,40) &= 1359.79 \\ S.E./\overline{TS} &= .0457987 \end{aligned}$$

Group Forty

This group is made up of horses, cattle, and pet dealers. The ability to estimate sound coefficients for this group would most likely be improved if horse and cattle dealers were one group and pet dealers another. There is undoubtedly an aggregation problem involved in combining two dissimilar types of goods such as these. Since the state reports the data in this manner there is no alternative to estimating the coefficients of the combined group. The taxable sales results are

$$GS40 = \underset{(3163.38)}{2890.52} - \underset{(.001487)}{.001484}(RFY) + \underset{(.00000000017)}{.00000000037}(YSQ)$$

$$+ \underset{(.000141)}{.000468(BX40)} + \underset{(.000077)}{.001056(QS1)} + \underset{(.000076)}{.000252(QS2)}$$

$R^2 = .9626$

$DW = 2.1481$

$F(5,36) = 185.229$

$S.E./\overline{GS} = .1400488$

where BX40 is a slope change variable from quarter 2, 1971, until quarter 2, 1974. The taxable sales results are

$$TS40 = \underset{(103.075)}{519.218} + \underset{(.012605)}{.243828(GS40)}$$

$R^2 = .9046$

$DW = 1.3498$

$F(1,40) = 379.150$

$S.E./\overline{TS} = .1679793$

The slope change variable is entered at the time that the base was changed to exempt the sale and rental of seeing-eye dogs and food for such dogs. The volume of sales of these dogs and their food does not impress the investigator as sufficient to cause a significant change in the relationship between gross sales and income, although no other reason for this change can be located.

Group Forty-one

This group is comprised of bottlers of beer and soft drinks. The results of the gross sales regression are

$$GS41 = \underset{(11418.4)}{-9786.55} + \underset{(.005017)}{.012960(RFY)} - \underset{(.00000000052)}{.00000000126(YSQ)}$$

$$+ \underset{(.000297)}{.000838(QS3)}$$

R^2 = .3357

DW = 1.6367

F(3,38) = 6.40059

S.E./$\overline{GS}$ = .1709796

The taxable sales equation results are

$$TS41 = \underset{(1022.75)}{-4035.89} + \underset{(.045349)}{.280941}(GS41)$$

R^2 = .5126

DW = 1.6257

F(1,40) = 42.0697

S.E./$\overline{TS}$ = .3370892

Group Forty-two

Those establishment groups that the Department of Revenue refers to as miscellaneous make up group forty-two. The data reflect a very substantial change between quarter 1 and quarter 3 of 1969 (quarter 2 appears to be a transitional period between the two). Close inspection of past base changes shows that the only base change that may have precipitated this change in group forty-two is the exemption of tangible personal property which has been used in another state for six or more months. There is no other explanation available during this specific time period.

The results of the gross sales regression are

$$\begin{aligned} GS42 = \underset{(131920)}{-174472} + \underset{(.047573)}{.063657}(RFY) - \underset{(.00000000423)}{.00000000436}(YSQ) \\ + \underset{(.000556)}{.000656}(QS1) \end{aligned}$$

$R^2 = .7874$

$DW = 2.1601$

$F(3,16) = 19.7491$

$S.E./\overline{GS} = .1375734$

The taxable sales equation yields the following:

$$TS42 = \underset{(3905.44)}{7778.32} + \underset{(.085832)}{.301363}(GS42)$$

$R^2 = .5732$

$DW = 1.2739$

$F(1,18) = 24.1763$

$S.E./\overline{TS} = .1905305$

These coefficients are estimated for quarter 3, 1969, through quarter 2, 1974, only. The data for observations previous to quarter 3, 1969, are so different from the data used in these estimations as to appear to be from a different group.

Group Forty-three

Feed and seed stores make up group forty-three. The results of the gross sales equation are as follows:

$$GS43 = \underset{(7999.7)}{78335.2} - \underset{(.003518)}{.018629}(RFY) + \underset{(.00000000037)}{.00000000222}(YSQ)$$

$$+ \underset{(.000242)}{.000680}(QS2) - \underset{(.000251)}{.001883}(QS3) - \underset{(.000248)}{.000549}(QS4)$$

$R^2 = .8442$

$DW = 1.6317$

$F(5,36) = 39.0124$

$S.E./\overline{GS} = .0659871$

The taxable sales regression results are

$$TS43 = \underset{(1487.04)}{-4938.29} + \underset{(.034611)}{.270675}(GS43) + \underset{(.000100)}{.000301}(QS3)$$

R^2 = .5873

DW = 0.7397

F(2,39) = 27.7531

$S.E./\overline{TS}$ = .1549823

Group Forty-four

This group is made up of farm implement dealers. The results of the gross sales regression are

$$GS44 = \underset{(7165.7)}{46133.8} - \underset{(.003144)}{.011155}(RFY) + \underset{(.00000000033)}{.00000000184}(YSQ) + \underset{(.000179)}{.000634}(QS2)$$

R^2 = .9234

DW = 1.1360

F(3,37) = 148.667

$S.E./\overline{GS}$ = .0655973

The results of the taxable sales regression are

$$TS44 = \underset{(773.222)}{-1092.00} + \underset{(.020618)}{.568995}(GS44) + \underset{(.000090)}{.000172}(QS3) + \underset{(.000083)}{.000188}(QS4)$$

R^2 = .9564

DW = 0.8224

F(3,37) = 270.333

$S.E./\overline{TS}$ = .0515082

Note

1. See Table I for complete information concerning the composition of each group.

APPENDIX II

DATA INFORMATION

Sales and Tax Data

Gross sales, taxable sales, and tax revenues are available quarterly from the Florida Department of Revenue. The data are reported in eighty-five establishment classes and in this study have been gathered into forty-four groups (see Table I).

It is very important to point out that the reports filed each month with the Department of Revenue are for sales made the previous month. For this reason the first quarter report each year is actually for sales made during the months of December, January, and February. Each of the quarters is reported one month late in these available data.

The sales and tax data are reported in thousands of dollars, unadjusted. As pointed out in the text, seasonal fluctuation variables are used to compensate for the fact that these data are not seasonally adjusted while the available measure of income is seasonally adjusted.

Income Data

The quarterly income figures used here are from the United States Department of Commerce as printed in the Survey of Current Business [29]. The figure used is total personal income in millions of dollars, seasonally adjusted at annual rates. In order to use like units in the regressions, these data have to be adjusted to quarterly rates, measured in thousands of dollars. Thus, the income data is divided by four and then multiplied by one-thousand; or, for simplicity, multiplied by two-hundred-fifty.

Price Data

The price information used to adjust the sales and income data is from the data file of Data Resources, Incorporated, and was developed by that firm. The price data used are United States data because no comparable quarterly price data are available for the state of Florida.

Base and Rate Changes

Information pertaining to specific base and rate changes is gleaned from an unpublished summary, "Changes in Sales and Use Tax Law: 1960 to Date," obtained from the Florida Department of Administration [10]. This summary is of immeasurable value in the determination of base and rate changes over the period of the sample.

APPENDIX III

AUTOCORRELATIONS AND FIRST DIFFERENCES OF THE TAXABLE TO GROSS SALES RATIO

LAG	LEVEL OF AUTOCORRELATION	FIRST DIFFERENCE
1	0.72	-3.929
2	0.60	-0.053
3	0.58	-0.335
4	0.60	1.143
5	0.46	-0.932
6	0.30	-1.279
7	0.24	0.019
8	0.19	1.134
9	0.05	-0.140
10	-0.12	-1.525
11	-0.16	-0.109
12	-0.21	1.163
13	-0.29	0.535
14	-0.39	-1.271
15	-0.43	0.295
16	-0.42	0.686
17	-0.39	1.405
18	-0.36	0.956
19	-0.36	-0.733
20	-0.32	1.026
21	-0.31	0.065
22	-0.30	-0.403
23	-0.22	0.156
24	-0.15	0.546
25	-0.06	2.300
26	-0.09	-2.229
27	-0.01	0.410
28	0.01	0.054
29	0.03	-0.108
30	0.00	-1.187

LAG	LEVEL OF AUTOCORRELATION	FIRST DIFFERENCE
31	0.06	1.194
32	0.07	-0.232
33	0.06	-0.391
34	0.04	-0.966
35	0.04	-0.001
36	0.07	1.459
37	0.04	-1.013
38	0.02	-1.271
39	0.02	0.295
40	-0.02	-0.940
Standard Error	1.66	1.138
Mean	--	-0.120

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BIOGRAPHICAL SKETCH

George Rodney Thompson was born in Fort Myers, Florida on September 2, 1946. In 1947 his family moved to Prattville, Alabama, a suburb of Montgomery, where he graduated from Autauga County High School in 1964. After attending the University of Alabama in Tuscaloosa for two and one-half years, and studying in several areas including physical education, biology, and secondary education, he decided to leave school and work until an area of study could be chosen.

From March of 1967 until September of 1968 he was employed by U.S. Steel as a metallurgical analyst in the blast furnace division of their Gary Works. In September of 1968 he moved to Chicago where he was employed by the Hewitt-Robins Precision Gear Division of Litton Industries as a Sales Service Engineer.

In August of 1970 he left Chicago and returned to Alabama where he enrolled in the School of Business at the University of Alabama in Birmingham. He received his Bachelor of Science Degree in June of 1972.

In September of 1972 he was offered and accepted an assistantship from the Department of Economics at the University of Florida. Since that time he and his wife, Mary, have resided in Gainesville, Florida.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Associate Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Economics in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June, 1976

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